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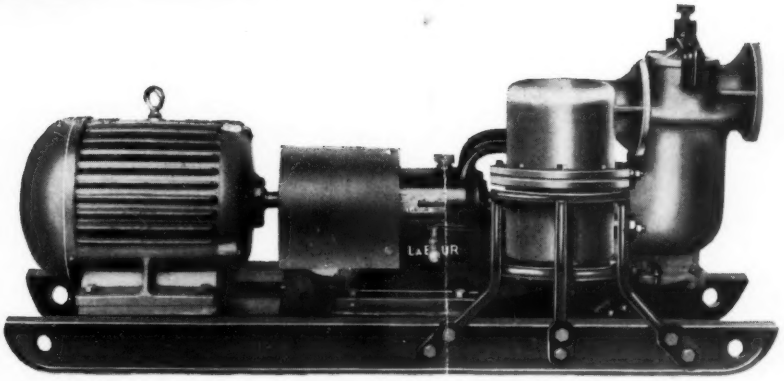

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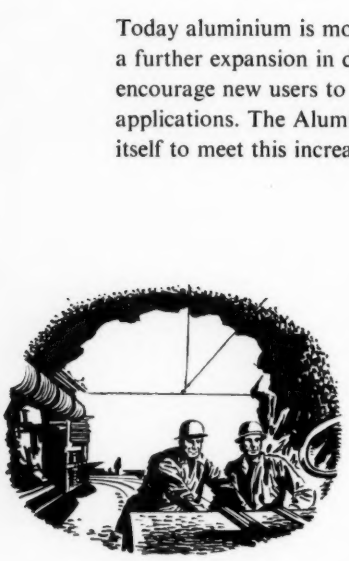

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The Mining Journal

London, February 20, 1959

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Problems of the Lead and Zinc Industry

SOME illuminating comments on the problems of the lead and zinc industry are contained in a report drawn up by the Non-Ferrous Metals Committee at its 34th Session in September last year. Entitled "The Situation of the Lead and Zinc Mining Industry in Europe", the report sets out to provide information on the scale of the difficulties facing the industry as a result of the sharp fall in the price of these metals in 1957. Prices have since improved, but the basic elements in the situation remain unchanged.

All O.E.E.C. countries except Belgium, the Netherlands and Switzerland, produce lead and zinc ores. Germany, Italy, Sweden and France produce 82 per cent of total O.E.E.C. production of lead ores and 87 per cent of zinc ores. These countries, Belgium and the United Kingdom represent about 77 per cent of lead metal and 90 per cent of zinc metal production in the O.E.E.C. area. Whereas a substantial part of ores and concentrates is treated by integrated smelters, another part is sent to custom smelters which are dependent on purchasing ores and concentrates.

In round figures the mine outputs of the O.E.E.C. countries amounted in 1957 (in terms of recoverable metal) to 215,000 tonnes, of lead and 320,000 tonnes of zinc, but refined metal production was 571,000 tonnes and 793,000 tonnes respectively. For O.E.E.C. countries as a whole, 30 per cent of total refined lead and 15 per cent of total refined zinc is produced from scrap. It will be apparent from these figures that the O.E.E.C. countries are substantial buyers of imported ores.

The report points out that smelting capacity in the O.E.E.C. countries combined and in the U.S. as well exceeds the mine output and availabilities of domestic scrap in these areas which have, therefore, to import ores and concentrates. Moreover, O.E.E.C. countries as a whole are dependent on imports of both metals for their consumption.

The market situation is thus influenced by international trade in ores, concentrates and metal on a world-wide basis. Ores and concentrates are imported into the O.E.E.C. area from Africa, Australia, Canada, Peru and Spain; lead and zinc metal mainly from Australia and Canada. Since the beginning of 1957 both metals, and in particular zinc, have been imported from Eastern countries, zinc imports amounting in 1957 to one-third of total net imports from outside the O.E.E.C. area.

Emphasis is placed on the difficulties and risks generally involved in the mining industry, which are particularly acute in European lead and zinc mining. Most European deposits have complex ores containing lead and zinc, which closely links the production of these two metals. In many cases other materials as well are found in the orebodies. A considerable part of the European mining industry is not located near or in highly-industrialized areas.

The point is also made that mining operations have to be based on long-term planning. This is true not only for the initial prospecting, demonstration and opening of orebodies, the study of ore treatment and the equipment of concentration plants, but also

for current exploration and development once the mine is opened, in order to ensure the steady activity needed. Thus, production is by nature inelastic and unable to adjust itself to short-term market fluctuations. The financial risk involved is, therefore, exceptionally high. Expenses for the maintenance of mines, where production is curtailed or stopped, are considerable. Skilled labour is needed and labour costs—representing up to 60 per cent of total costs—may rise, and have done so, when metal prices fall.

When mining operations are stopped and pumping ceases, flooded mines may be heavily damaged or even ruined so that future restarting of work may be difficult or impossible.

The report recalls that, in spite of the closing down of some mines, mine production in O.E.E.C. countries as a whole rose during the crisis. This seeming paradox is accounted for partly by the inelasticity of mine production, the impossibility of stopping certain projects under way, and the existence of long-term delivery contracts. A second reason was that, although suffering losses, many companies took no decision to eliminate marginal production, mainly because of the policy of full employment applied by some governments. Finally, in order to maintain the necessary equilibrium of their budget, some mining companies had to react to the price fall and reduction of their income by reducing their expenditures and at the same time increasing low-cost output (i.e., exploitation of the richest ore deposits). This policy neglects development and research work and diminishes the value of the mine.

Analysing the effects of recent events on Europe's lead and zinc mining industry, the report lays stress on two salient facts. In the first place, the lead and zinc market has been made, and kept, extremely weak by persistent overproduction in the world during the last four or five years and the resultant accumulation of stocks in certain countries, aggravated by the recent appearance of supplies (chiefly of zinc) from Eastern Europe.

In the second place, two distinct policies are followed in the various Western countries. Some countries protect their mining industries: others do not. Countries which have not adopted protectionist policies suffer, or are likely to suffer, as a result of the increase in production in countries where the mining industry is encouraged or supported.

The Non-Ferrous Metals Committee realized long before the crisis in May, 1957, the dangers latent in this state of affairs, especially in the lack of co-ordination between the principal countries in regard to economic policy and in the price fluctuations that were bound to result sooner or later on the free markets. It studied the question of reducing short-term fluctuations in lead and zinc prices and remains convinced that this is the key to the harmonious development of production capacity in the various countries and the progressive abolition of obstacles to international trade. Its study in 1954-55 was a failure, however, mainly because no action of this kind could be effective if confined to the countries of the O.E.E.C.

The hope is expressed that a study of this kind might be tried on a bigger scale to cover all the countries concerned, its principal objective being to keep those mines open where costs are lowest, only closing down those where costs are abnormally high, so that all consumers' needs can be met as cheaply as possible.

Two international conferences on world lead and zinc problems have recently been held, one in London and the other in Geneva, but without arriving at any agreement that would inject price stability into the markets for these metals. A third meeting of leading lead and zinc producing nations was to have been held this month under the auspices of the United Nations, but has been postponed.

Advocates of an international approach to the difficult and controversial problem of price stabilization will welcome the O.E.E.C. report, from which it emerges very clearly that the issue is not between freedom and control, but whether the restrictive measures adopted by individual nations (the most notorious example being, of course, the U.S. import quotas) could not with advantage be superseded by a co-ordinated system of world control. According to the *Journal of Commerce*, the United States would like to end its quotas on lead and zinc imports, but is unwilling to do so until other producers limit their output and exports.

Now that Canada has agreed to a U.S. proposal to seek an international conference on lead and zinc, the third meeting is unlikely to be much longer delayed (there is now talk of April). It is to be hoped that this time some constructive proposals will emerge.

MORE HOME ORE FOR BRITAIN'S BLAST FURNACES

The iron and steel industry presents some strange contrasts. The recession has proved to be deeper and more prolonged than was first realized. There has been a sharp relapse in steel production from the peak United Kingdom figure of 21,700,000 tons in 1957 and, chastened by that experience, the industry has indicated the probability of an output not exceeding 20,000,000 tons in the current year, although capacity is now rated at 24,500,000 tons. In short, the steel makers are budgeting for a continuance of the recession.

Reviewing the operations of the mighty United Steel Companies over which he presides, Sir Walter Benton Jones spoke of an average working level of 80 per cent; and as to prospects, the best he could promise was that this level, according to present indications, could be maintained. Nevertheless, this group has increased its capital expenditure in the past year to £14,000,000, that is £3,000,000 more than the average for the past five years, and this policy of unfaltering expansion and re-equipment is general throughout the industry.

It is a significant fact that the £600,000,000 Five-Year Development Plan has only been modified to the extent that completion may be deferred for a year. On the other hand, the decision to adopt the judgement of Solomon in regard to the long-protracted fourth strip mill, giving one-half to South Wales and the other half to Scotland, will *increase* the industry's capital expenditure over the period by a further £100,000,000.

Quite clearly, the British steel industry's faith, shared also by all the principal steel producers of the world, is that recent events represent no more than a temporary interruption in the rise of world steel requirements and of actual production, which has been continuous since the dawn of the century.

For the moment the pressure for the raw materials of steel making has been substantially relaxed. In the United States, where the steel slump has been even more catastrophic than in this country, the demand for iron ore has fallen very sharply and the drop in prices has been accentuated by the fall in ore freights. For steel companies with the necessary finances, and, still more necessary, the requisite storage space, this appears to be an opportune time to accumulate big stocks of imported ores, although there are obvious limits to the pursuit of a policy of stockpiling.

Records of the industry over a long period of years reveal a definite trend towards the use of a larger proportion of imported ores for the nourishment of Britain's blast

furnaces. But it is still the fact that more than half the tonnages of ore used in this country come from our own ore fields, namely: 17,000,000 tons in 1957 out of a total of 31,000,000 tons.

With a very much larger iron content foreign ores are still, and will continue to be, required, because our steel makers have mastered the techniques of making the maximum use of the iron ores of low iron content which are still available in the Humber-Severn belt. This is strikingly exemplified at United Steel's Appleby Frodingham works where the smelting of local ores, prepared as 100 per cent sinter, is carried out with such efficiency that one of the four new blast furnaces achieved a total output of 11,750 tons of pig iron in a single week, easily a record for any furnace in this country.

Obviously, such performances sound the death-knell of the older-type blast furnaces of small capacity in the integrated steel works, though some of these may continue to be operated for the production of merchant iron. It also connotes a further rise in the consumption of home ores.

Extraction of these ores since the war has been stepped up from 12,000,000 tons in 1946 to 17,000,000 tons in 1957 and the industry plans to raise this annual rate to at least 22,000,000 tons by 1962. In this field also, Appleby Frodingham is playing a leading role. As in coal mining the recovery of iron ore by opencast working offers substantial economies and this form of extraction is fully exploited. It now transpires that the mining operations at Scunthorpe are also being extended and a new mine has also been brought into operation in South Lincolnshire.

Thus, the shape of things to come gradually emerges: the rising consumption of home ores and their pre-treatment before transference to the blast furnaces. Whether old or new they are all producing more iron on a reduced fuel consumption, and within the course of the next decade, it is believed that elimination methods of reducing ore to metallic iron which do not depend on the consumption of metallurgical cokes may be developed.

DEVELOPMENT PROJECTS FOR THE BELGIAN CONGO

Union Minière will invest about 1,000,000,000 Belgian francs annually in new enterprises over the next 12 years, beginning this year, according to M. J. Cousin, chairman of the company's local committee. M. Cousin is reported as stating that, if the company could be certain that its concession would be prolonged, it would probably increase its annual investment programme to 2,000,000,000 francs immediately and would open "one or several exploitation centres".

M. Cousin also stated that a new opencast mine was on the point of being started up at Lupote. This would be exploited by manual labour so as to provide employment for as many men as possible.

In 1958 Union Minière produced 235,500 tonnes of copper. A year ago it was decided to reduce production to 90 per cent of the 1956 figure, which would have given a 1958 output of some 222,000 tonnes. However, production was increased in October because of the improvement in the world copper market, and also to increase stocks.

According to M. van Hemelryck, Belgian Minister for the Congo, a large bauxite orebody has been discovered in the Lower Congo and its development will call for an investment of £40,000,000-£50,000,000. The discovery of a local source of aluminium is important as furnishing an additional incentive to begin the development work on the huge hydro-electric project for the development of the large area on the Lower Congo.

A report from Brussels states that the power target for the first stage of the development of the Inga project may be only 700,000 kW., instead of the 1,570,000 kW. initially foreseen by the Belgian Government. It is understood that Institut National d'Etudes pour le Development du Bas Congo is of the opinion that an installed capacity of 700,000 kW. would provide competitively-priced current that would attract foreign consumers at an overall cost of less than 7,000,000,000 Belgian francs, whereas preliminary plans (for 1,570,000 kW.) would have cost about 15,000,000,000 francs.

The report further states that, whereas it was first thought that some 80 per cent of the power produced at Inga would be used for the production of aluminium, it was now expected that only 20 per cent of the capacity would supply such plants. Possibly the new bauxite discovery may lead to a further revision of the government's plans

URUGUAY SEEKS MINERAL WEALTH

Uruguay is once again showing marked interest in her mineral resources. Past surveys have proved the existence of manganese and iron ore but not of sufficient promise to make their exploitation an economic proposition. Now, with the increase in world prices, Uruguay, considers that mining prospects have improved and has endeavoured to enlist the aid of German capitalists.

The Bonn Government has offered to send two geologists to carry out a survey of Uruguay's manganese and iron deposits. Also, at the request of Uruguay, the Technical Assistance Administration of the United Nations has agreed to investigate the country's mineral resources and will be submitting a report before March 31.

EXHIBITION AFLOAT

An unusual method of boosting exports has recently been exploited by the General Export Association of Sweden. The Association arranged with the Swedish Transatlantic Line for 250 Swedish firms to exhibit their products on board the M.S. *Elgaren*. This ship has recently returned to Sweden after touring South and East African ports.

This modern version of bringing the mountain to Mahomet is not altogether a novel idea. A year or two ago, a floating exhibition arranged by Japanese industry visited a number of Far Eastern countries, apparently with considerable success, and doubtless there have been other examples.

There appear to be obvious limitations as to the range of equipment which could be included in a floating exhibition, more especially in so far as the larger items of mining machinery are concerned, but with effective use of the available floor area, it is possible for a considerable number of firms to stage comprehensive and striking displays within the confines of a single ship, as the Swedish experiment clearly shows.

We commend Sweden's venture to the British mining machinery industry as appearing, on the face of it, to be an economical and extremely effective way of bringing its products to the notice of the maximum number of potential buyers in promising markets. The publicity accorded to a floating exhibition in each of the countries visited should in itself be extremely valuable to British manufacturers seeking to establish new markets for their products or to expand their existing export trade.

Development of Cemented Tungsten Carbide Tipped Drill Steels

From a lecture by Curt Dahlin, Sandvik Steelworks, Sandviken, Sweden, on the occasion of the Second Annual Symposium on Mining Research, in the University of Missouri, School of Mines and Metallurgy, Rolla, Missouri, November, 1956.

AFTER the invention of cemented tungsten carbides in Germany during the twenties, it was not long until the new material was tried out also as inserts for rock drill steel. The first drill steel provided with a T.C. insert was tested in Germany in 1928, and early development work was for a while wholly confined to that country.

Subsequent developments have followed two major lines. On the one hand, efforts have been directed at obtaining detachable T.C. bits to supersede forged detachable steel bits. This line has been pursued in many different countries, especially in the United States.

The other line involved the replacement of drill rods made of carbon steel or alloy steel, provided with forged bits, with alloy drill steel fitted with a T.C. insert brazed to the rod. This line has been the one principally followed in Sweden, where particularly during the past ten years a tremendous amount of research has been devoted to the development of this type of drill steel. The work has led to substantial improvements in quality, and as a result integral steels with T.C. inserts have become widely accepted throughout the world. The number of integral steels consumed can be estimated at about 3,000,000 a year.

The integral steels are principally employed in drilling small gauge holes, in the range of 0·95 in. to 1·65 in. It can be estimated that of the total production of small gauge holes throughout the world today more than 75 per cent are drilled with integral steels.

Design and Dimensions of Integral Drill Steels

The most common section is a hexagon of $\frac{3}{4}$ in., $\frac{7}{8}$ in., and 1 in. in size. Flat flexible steel 1 in. by $\frac{1}{2}$ in. is also used but much less commonly, and round $\frac{7}{8}$ in. to an even lesser extent. In South Africa, where about one-third of all integral steels manufactured in the world are consumed, about 60 per cent are $\frac{7}{8}$ in. and 40 per cent 1 in. in size (hexagon), which is the principal reason why the figure for the 1 in. steel is as high as 15 per cent. In the rest of the world the consumption of 1 in. steel probably does not exceed 2 per cent. The most common design of shank is one provided with a forged collar. In addition to collared shanks, steels are manufactured with plain shanks, although to a much lesser extent, for use in rock drills fitted with anvil blocks.

In South Africa two other types of shanks are used. Of these two the most common one is the so-called rubber collar consisting of steel elements with rubber packing fitted to the rod ; the other type has about $1\frac{5}{8}$ in. of the butt end machined to a round section. A $6\frac{1}{4}$ in. shank is generally used with the rubber collar on $\frac{7}{8}$ in. and 1 in. steels. The rubber collar shank works satisfactorily in South Africa where a relatively low air pressure is used, but with higher pressure the collar tends to slide.

In patent literature one may find numerous designs of bits, but the only types which have come into common use are the chisel and four point bits. Of the two, the chisel bit is by far the most common, accounting for more than 97 per cent of all integral steels manufactured.

Fig. 1 shows a typical chisel bit, 1·30 in. gauge size, together with the most common measurements for cutting edge radius, edge angle, and clearance angle. The values given are those found most suitable in most cases and deviations from them are seldom required. On the very infrequent occasions when deviations may be warranted there is usually no need to manufacture special integral steels. Regular bits are simply reground, either before being put to use or at the first regrinding, to the shape found most suitable to the particular case involved.

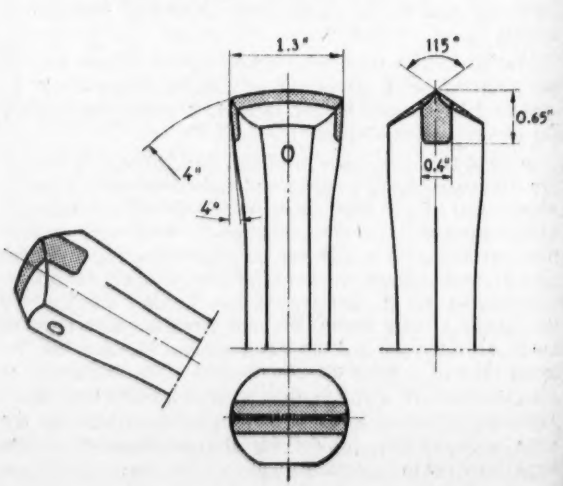
The reasons why the chisel bit has found such wide use are the following : its drilling performance is very good ; it is easy to regrind ; it provides a solid support for the carbide insert, and besides, it is easier to manufacture than any other type of bit.

Fig. 1 also shows the section of the T.C. insert most commonly used. When tungsten carbide bits were first introduced the inserts were usually given a thickness of 0·30 in. and a height of 0·50 in. However, as the quality of the steel improved, it has become possible to utilize an increase in the height and thickness of the insert and today the most common size is 0·4 in. by 0·65 in.

In order to reduce the number of different sizes of drill steels, rod lengths and bit gauges have been standardized in Sweden. These standard drill steel series have in recent years obtained wide acceptance, except in South Africa where standardization is not yet a fact. In other markets about 70 per cent of the drill steels sold conform to these standard series.

Occasionally it is desirable to drill deeper holes than permitted by the height or width of the stope. Obviously, it is then impossible to use regular steel series and instead

Fig. 1. Design of the most common drill bit, the chisel bit.



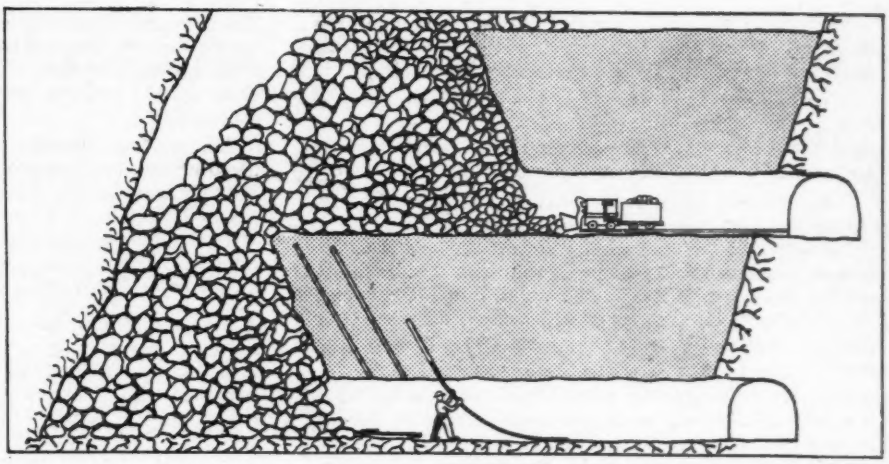


Fig. 2. Flexible steel used in sublevel caving.

flexible steels are employed. These steels can be flexed to a radius of about 8 ft. without permanent set.

Fig. 2 shows how flexible steel is employed in sublevel caving.

In addition to improving the design of the integral steels, research has also been aimed at improving the characteristics of the cemented tungsten carbides, the method of brazing the insert to the steel, as well as the steel itself.

Cemented Tungsten Carbide

The early tungsten carbide inserts were tough but less wear-resistant, since the methods of carbide manufacture and brazing were as yet undeveloped, and the rock drills available at the time were not designed for use with carbide inserts.

It is, however, interesting to note that the inserts used today contain the same principal elements as the early ones, namely, tungsten carbide, which imparts wear resistance to the insert, and cobalt, which imparts toughness. The difference lies in the considerable improvement in quality, which has been obtained partly by better manufacturing processes resulting in a uniform quality and absence of porosity, and partly by better grain structure.

The carbide grain size is of fundamental importance for the quality of the insert, as is also the cobalt content.

Results are from drilling in granitic leptite.

As shown in Fig. 3 wear resistance can be improved either by reducing the cobalt content or the carbide grain size. Toughness, on the other hand, can be increased either by increasing the grain size or the cobalt content.

As a measure of " toughness " it is possible to apply the height of the insert remaining at failure. Tough carbides can be worn down to very small heights before ultimate fracture, whereas brittle carbides fracture at considerably greater insert heights.

In judging the quality of a certain T.C. insert the deciding factors must be both long service life and wear resistance, since the latter property determines the frequency of re-grindings. Finally, the insert must also be sufficiently tough to minimize the risk of premature fracture.

To obtain maximum footage it is necessary to balance toughness and wear resistance, which from a manufacturing point of view means obtaining a proper balance between cobalt content and carbide grain size.

The early carbides applied to rock drilling usually contained 13-15 per cent cobalt and the carbide grain size was in the order of 1·5-2 microns. Owing to redesign of the rock drills for use with T.C. inserts and also to improvements in carbide manufacture and methods of brazing, it has been possible to introduce carbide grades with a far greater wear resistance, despite the increase in brittleness.

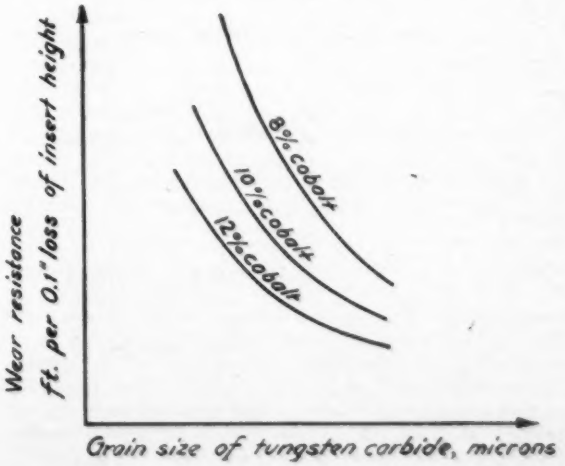
These developments have made possible the utilization of carbides with a lower cobalt content, but at the same time an increased carbide grain size insures sufficient toughness, so that a favourable balance between wear resistance and toughness is achieved. Leading manufacturers of integral steels today use carbide inserts containing 8-10 per cent cobalt and with a grain size of about 3 microns.

The Steel

In drilling the steel is exposed to fatigue stresses imparted by the percussions of the rock drill. The number of impact stresses is directly proportional to the actual time of drilling, or in other words the number of blows delivered by the rock drill. As a rule, fatigue stresses ultimately lead to steel fracture, which earlier frequently occurred in the soft zones resulting from heat treatment of the steel.

In order to make possible an increase in the hardness of the drill steel as hot rolled and thereby obtain a higher fatigue limit, carbon steel with a hardness of 25 Rc has been replaced by alloy steel with a hardness of 40 Rc.

Fig. 3. Relationship between wear resistance (feet per 0.1 in. loss of insert height) and grain size of tungsten carbide for various cobalt contents.



At the same time the surface finish has also been improved by means of better methods of manufacture, thus allowing full utilization of the superior hardness of the material.

A typical analysis of alloy steel in common use today in drill steel manufacture would be as follows : Carbon 1·0 per cent, Silicon 0·2 per cent, Manganese 0·3 per cent, Chromium 1·0 per cent, Molybdenum 0·3 per cent.

If the steel is simultaneously exposed to fatigue stress and corrosion the fatigue diagram presents an altogether different appearance. In this case there is no marked limit and the fatigue resistance declines continuously with the increasing number of cycles. When drilling under normal conditions, the mean stress on the steel is well below the fatigue limit without corrosion. In other words, a steel fracture should not occur.

However, in production drilling the drill steel is always exposed to corrosion, which ultimately results in fatigue fracture due to the lowering of the fatigue resistance of the steel by corrosion. Obviously, to improve the fatigue resistance of the steel it becomes necessary to find some means of inhibiting the corrosion.

Some manufacturers have provided the flushing hole of their steel with a 13 per cent chromium stainless lining of about 0·025 in. in thickness in order to inhibit corrosive attacks and thus improve the fatigue resistance of the steel.

In recent years a new manufacturing process which includes a chemical surface treatment has been developed in Sweden by The Sandvik Steel Works, Co., Ltd., Sandviken, Sweden, which gives drill steels better protection against corrosion. The new method provides efficient corrosion protection both for the flushing hole and to a certain extent for the outside surface of the drill steel. It permits raising the fatigue limit of the steel to very near that prevailing under non-corroding conditions.

The new anti-corrosion treatment protects the outside of the drill steels during transport and storage and for some time also in use, until the chemical surface treatment has been worn off.

With these new drill steels all inside fractures have, practically speaking, been eliminated, and the number of outside fractures has also been substantially reduced.

The fractures now experienced begin on the outside of the rod and the work in progress aims at improving the outside surface fatigue resistance of the steel. A number of methods have been tried in an attempt to induce residual compressive surface stress. These include surface hardening, nitriding, case hardening, spiral rolling, and shot peening.

In the development of integral steel interest has always been directed at the weakest part of the integral steel, since this part determines the footage. This is the reason why in recent years special interest has been paid to the soft zones.

The improvements, which are the result of all the research and development work discussed above, have led to an integral steel in which the different parts have about equal footage under most drilling conditions. It can therefore be expected that in the near future development of the different elements will run parallel, without emphasis on any particular part.

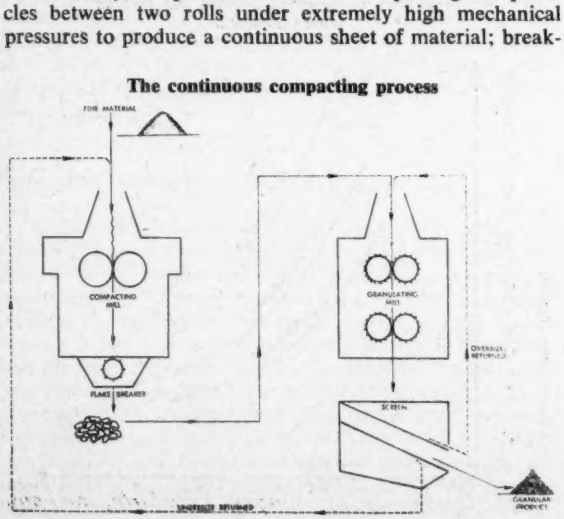
Reducing Waste at French Potash Mine

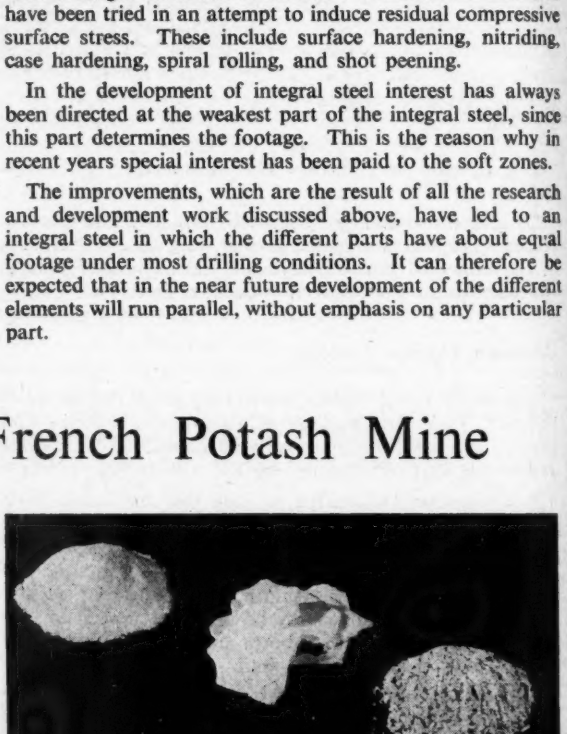
THE Allis-Chalmers continuous compacting process, for upgrading fine chemical salts, is planned for installation at a potash mine in eastern France. Potash is one of France's most important resources, with French mines producing 21 per cent of the Free World production.

The compacting process can be applied to all inorganic salts, as well as other materials where particle size, density, and solubility rate need close control. In many cases, these fines have been previously considered waste product of operations.

Essentially, the process consists of compacting fine particles between two rolls under extremely high mechanical pressures to produce a continuous sheet of material; breaking the sheet with a flake breaker; granulating the pieces between two corrugated rolls operated at differential speeds; and screening the product for desired size.

The continuous compacting process





Compacted salt from fines. From left to right, −30 mesh fines, compacted salt flakes, granules salt-screened at 10 mesh. Some 80 per cent to 90 per cent are recovered as a +10 mesh product

Allis-Chalmers equipment for the operations at this mine includes a compacting mill with rolls 18 in. in dia., 24 in. long, with 75 h.p. motor; two 10 in. by 42 in. granulating roller mills; a 4 by 10 ft. Aero-Vibe vibrating screen; and all Texrope drives

In the initial step the potash ore is ground in Allis-Chalmers rod mills. From a 4 x 10 mm. feed size it is reduced and screened to 90 per cent passing 0.8 mm. to prepare it for treatment by cold flotation process. The potassium chloride floats in the cells as the sodium chloride sinks. The potassium chloride is then dewatered and dried. The fine particle sizes are upgraded by compacting.

The Australian Mining Scene

IN his most recent dispatch, our correspondent in Australia gives a clear picture of the Commonwealth's mining industry as it stands in the opening months of 1959. It is reported that the Broken Hill Associated Smelters, the only Australian producer of refined lead, and the Electrolytic Zinc Co. of Australasia Ltd., the only producer of refined zinc, will raise the local selling price of lead and zinc to £A100 per ton for each metal.

An official statement has not yet been made, but the reported increase in price has not been contradicted. At the end of 1958 the local prices were £A85 12s. 6d. for lead and £A93 12s. 6d. for zinc. An increase to £A100 would be of considerable benefit to the Broken Hill mines and to the West Coast-Rosebery-Tasmania mines of the Electrolytic Zinc Co.

Domestic Consumption of Lead-Zinc

About 20 per cent of Australia's production of lead and 70 per cent of the zinc production is consumed by Australian industry. Lead production by the Broken Hill Associated Smelters, at Port Pirie, is 192,000 tons per year, of which 40,000 tons was used by local industry. Australian production of refined zinc from the Risdon, Tasmania, works is 110,000 tons yearly, of which 80,000 tons is used in Australia. The reported rise in price will not benefit Mount Isa mines or such small producers as do not use Australian smelting and refinery services.

In order to help in lessening overproduction of lead and zinc on the world's markets, and so help to maintain a better price, the Broken Hill mines about a year ago proposed to cut production by 10 per cent. This opening does not seem to have been followed by other lead-zinc producing countries, nor have Australian companies given serious co-operation.

Copper Production

In Broken Hill, production by the Zinc Corporation and New Broken Hill Consolidated has been substantially reduced, but there seems to be only slight reduction in the tonnage of ore mined by North Broken Hill and Broken Hill South. Any reduction in the tonnage of ore mined is more or less offset by an increase in the lead-zinc grade, so that the metal position would seem to be little affected. The West Coast mines of Electrolytic Zinc Co. continue a normal rate of output, with some recent increase in tonnage of zinc and lead recovered. Zinc production at the company's Risdon works is gradually increasing, and there is growing Australian demand for zinc metal.

Mount Isa mines are increasing the rate of production of all metals. The grade of crude ore remains practically the same, but a greater tonnage of silver-lead-zinc ore is being mined. In the copper section, the output of copper is being raised, but the full effect of the expansion will not be apparent until smelter capacity is brought up to the planned level. Increase in output of copper ore has been accompanied by a slight fall in grade.

Three copper mining companies, Mount Lyell, Mount Morgan, and Peko Mines, have increased output of ore. Mount Lyell's grade remains steady, but ore higher in gold and copper is being mined and treated by Mount Morgan, which is reflected in the metal output and in the finances. The company's affairs have been quite satisfactory since the granting of the £A45 per ton subsidy so as to maintain the Australian price for copper at £A330 per ton.

There is still no indication of the expected report by the Tariff Board on the Sulphuric Acid Bounty, from which assistance is hoped toward marketing increased tonnages of pyrite. Peko, the Northern Territory's one copper mine, has increased output of ore, and this company will benefit from the copper bounty.

Mount Isa's operations continue in the forefront of the mining industry. The big expansion programme is taking effect, and it has been reported recently that the mines are well on the way to the record treatment of 2,000,000 tons for the 1958-59 period. Total throughput for 1957-58 was 1,655,070 tons. In the first seven periods of 28 days each of the 1958-59 financial year, ore treated totalled 1,138,498 tons, which compares with 810,104 tons in the previous corresponding period.

New Life for N.S.W. Black Coal

The rebuilding of the black coal industry in New South Wales is making very satisfactory progress. Cost of coal is falling, resulting from extension of mechanization and increase of output per man-sh.ft. In addition, coal-washing plants are reducing the high ash content which accompanies mechanical mining, and demand for coal is stimulated, with the added selling point of a graded product.

In the past there have been serious losses in markets, most serious of all the loss of a great export market through industrial troubles; export of gas coal to Victoria has been lost through the manufacture of gas from brown coal; oil has cut heavily into sales of locomotive coal as dieselization is being extended on all railway. systems. Reorganization of the industry and cost reduction, in which the mechanical mining of pillar coal (long blocked by the unions) is playing an important part, has permitted the building up of the almost non-existent export trade, which now approximates 1,000,000 tons per year with good prospects of increase as the demand from eastern Asia grows. On the other side is the inevitable unemployment which results, as a given tonnage of coal can be produced by less men, and the present position is such that markets must expand before re-employment can be anything but gradual.

The future of the reorganized industry rests largely on export and also on the supply of coal to electric power stations being built, and to be built, in New South Wales. The policy is to build these stations on the coalfields and so avoid heavy transport charges. Although industrial conditions have greatly improved and less time is lost through strikes, there is still trouble, and one large colliery has been forced to close down through strikes which in the past six months have lost 90,000 tons of coal to the company concerned despite the lesson of growing unemployment.

New Search for Bauxite

A new search for bauxite has begun in far north Queensland by a newly-formed company, Dominion Pty. Ltd., over a 3,520 sq. mile area. The area extends over mineral-rich lands across the bottom of Cape York Peninsular. The company is one of a large group with Australia-wide interests headed by the Melbourne financier, Mr. Stanley Korman.

Keevil's $35,000,000 Mining Enterprise

By Claude H. Taylor

In this article our Canadian Correspondent outlines the growth of the Dominion's newest mining enterprise.

THERE is still much glamour and romance in the Canadian mining industry. And there are still many opportunities present to enable one to amass a fortune quickly.

A 48-year-old geophysicist has demonstrated that opportunities are still around in Canada, especially in the mining-financing field. Since last July, Dr. N. B. Keevil has parlayed a $1,000,000 speculation into a $35,000,000 mining enterprise. That's about equivalent to one-third the multi-million-dollar empire controlled by Noranda Mines, which has been accumulating in Canada since 1922. Originating through the Universities of Saskatchewan, Harvard, M.I.T., and Toronto, he moved into the mining geophysics business in Canada a few years ago.

By last July, Dr. Keevil's main participations consisted of Geo-Scientific Prospectors and Mining Geophysics Co., two corporations engaged in scientific exploration on their own account and for mining companies generally.

Up to this time the companies had successfully located, by geophysical methods, a high-grade copper deposit in the Temagami district, which hitherto had been regarded as one of Ontario's summer playgrounds. The companies thus controlled 44 per cent of the outstanding shares of Temagami Mining Co. The other principal assets of Geo-Scientific Prospectors and Mining Geophysics consisted of $500,000 each. The companies then acquired stock control of Goldfields Uranium Mines Ltd., a prospect trading on the Toronto Stock Exchange, for $540,000.

About this time, New Hosco Mines Ltd. pulled a high-grade core in drilling its ground in the Mattagami district of Quebec. Goldfields owned a block of New Hosco. The latter skyrocketed from pennies to over $7 in the course of a few market sessions. The block of New Hosco shares was sold for over $1,000,000 profit, and the Keevil interests were really in business, as the rest of the Canadian mining industry was soon to find out.

The New Hosco profit was used by the Goldfields-Geo-Scientific-Mining Geophysics team to acquire 23 per cent of Pickle Crow Gold Mines Ltd. The latter company in turn operated a 400-ton gold mill at Pickle Crow, Ont., controlled a hotel-beverage rooms, a telephone company, and a townsite, together with the services usually required in frontier towns.

Geo-Scientific and Goldfields Uranium then stepped out and acquired 17 per cent of Teck-Hughes Gold Mines Ltd. This represented the largest individual block of stock, so it gave the companies operating control.

Teck-Hughes has operated a gold mine in the Kirkland Lake district of Ontario since 1917, and had paid out dividends totalling $49,000,000 to the end of 1957. But, most important is that Teck also owned 81 per cent of Lamaque Gold Mines Ltd., which yields over $4,000,000 annually in bullion and has operated a 2,000-ton per day mill since 1935 in the Bourlamaque district of Quebec.

The Teck-Lamaque acquisition automatically gave Dr. Keevil an interest in Eldrich, which ships gold for processing to Noranda Mines' smelter at Noranda, Que. Teck-Lamaque also owned a one-sixth interest in Mattagami Lake Mines, which discovered a multi-million dollar zinc, copper, silver orebody in the Mattagami Lake district in 1957. This latter company is controlled by the Noranda, McIntyre Porcupine Gold Mines, Canadian Exploration Ltd. group.

The Teck-Lamaque group also owned varied percentage interests in several prospecting syndicates, controlled Teck Exploration Co., held important interests in "blue chip" mining stocks, and also owned a sizeable interest in Consolidated Howey Gold Mines, a prominent holding company.

Teck and Lamaque then bought the Rio Tinto of Canada holdings in Consolidated Howey to give the group 36 per cent of Howey's outstanding stock.

On surface, the Consolidated Howey deal appeared a modest purchase, as total assets at December 31, 1957, had only totalled $1,300,000. But taking investments at market value, the current position of Howey comfortably exceeds $12,000,000.

By moving into the Consolidated Howey, the 48-year-old geophysicist took a dominant position in the Canadian mining industry.

Consolidated Howey's interests included the following holdings: 463,000 shares of Geco Mines Ltd., which in turn is controlled by the Mining Corporation of Canada-Noranda Mines group of companies. Geco operates a 3,000-ton per day concentrator in the Manitouwadge district of Ontario, where ore reserves are estimated at 14,800,000 tons of 1.76 per cent copper, 3.75 per cent zinc, and 1.74 oz. silver per ton. Geco, selling at roughly $20, was discovered back in the summer of 1953 by three prospectors who became millionaires overnight.

540,000 shares of Willroy Mines Ltd., operating a 1,000-ton plus per day concentrator on the westerly boundary of Geco Mines, as well as rights on 200,000 additional Willroy shares at 60 c. per share. Willroy's reserves total 2,600,000 tons averaging 1.09 per cent copper, 6.49 per cent zinc, 0.25 per cent lead, and 2.34 oz. silver. The stock sells in the $2.25 to $2.30 range.

25,025 shares of Lamaque Gold Mines, selling at over $3 per share; 153,500 shares of Teck-Hughes Gold Mines, selling about $2.50 per share; 277,000 shares of East Amphi Gold Mines, a penny stock holding a modest tonnage of gold ore in the Malartic district of Quebec; varied interests in lesser-known companies, of which some show spasmodic activity.

The six- to seven-month parlay of $1,000,000 to $35,000,000, needless to say, has placed Dr. Keevil in the forefront of the Canadian mining industry.

It is unlikely the parlay is finished in view of the Keevil group now being a key factor in the operation of four gold mines, and at least having a say around the directors' table in the operation of two base metal mines.

It would be safe to assume that broadening activity will be experienced over the next few months by this comparatively new mining enterprise. Thriving on work and pressure, it is expected Dr. Keevil will now use his scientific knowledge to explore further the ore potential of the producers he is now directly associated with. Attention, in all likelihood, will also be turned to extensive acreage controlled by the group, as for the first time in some years there seems to be an abundance of money around to accelerate the mine-finding and mine-development technique of Dr. Keevil and his large staff of geophysicists, geologists, and engineers. The original Geo-Scientific Prospectors-Mining Geophysics Co.-Temagami Mining payroll of possibly 100 workers has now swelled to some 1,500 through the parlay.

Technical Briefs

Solvent Extraction of Uranium

The use of solvent extraction is on the increase for the recovery of uranium from leach liquors. A common solvent is dodecyl phosphoric acid (DDPA) diluted with paraffin, but di-2-ethyl hexyl phosphoric acid and tri-butyl phosphate are also employed dissolved in paraffin. Sometimes the solvent is prepared in plants by reacting phosphorus pentoxide with the alcohol used and sufficient paraffin to maintain the maximum temperature of 80 deg. C., subsequently being hydrolyzed by adding some hydrochloric acid.

Before solvent extraction takes place, the leach slurry is reduced by addition of a sulphide such as sodium hydrosulphide. Solid-liquid separation usually takes place by counter-current decantation, and clarification is generally unnecessary. The actual reaction usually takes place in a turbo-mixer followed by separation of the two liquids. An impeller mixer with a deep conical tank below the mixing zone is said to be simple, provides little emulsion, and allows separation to take place in the mixing tank. Stripping is usually completed with hydrochloric acid.

ELECTRICAL-RESISTIVITY SURVEYS

The value of electrical-resistivity surveys in exploring certain types of lead-zinc deposits is appraised in a new U.S. Bureau of Mines publication. The Bureau's evaluation of the method is based on results of an extensive field investigation carried out in co-operation with the Geological Survey in the vicinity of the Badger-Peacock mining camp, Cherokee County, Kans. This area was studied because it is similar, geologically and topographically, to a large part of the Tri-State lead-zinc district, and conclusions derived from the study would, therefore, have relatively wide application.

After making more than 13,000 resistivity observations in a 3¼ sq. mile area, the Geological Survey prepared contour maps and profiles which were used by Bureau of Mines' engineers in churn-drilling 96 test holes, totalling over 17,000 ft. Logs of the churn-drill holes then were correlated with the information obtained in the resistivity surveys.

According to the Bureau's report, the investigation showed electrical-resistivity techniques give accurate information on the presence of underground structural conditions with which ores are commonly associated. Use of this method, the report says, "eliminates unnecessary exploratory drilling in undisturbed areas and localizes drilling to areas or zones of low resistivity where the possibilities for discovering zinc and lead orebodies are most favourable".

A copy of Report of Investigations 5426, "Practical Evaluation of Electrical-Resistivity Surveys as a Guide to Zinc-Lead Exploratory Drilling, Badger-Peacock Camp and Vicinity, Cherokee County, Kans.", can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Avenue, Pittsburgh 13, Pa.

IRON OXIDE SLIME COATINGS IN FLOTATION

A quantitative method for evaluating the density of slime coatings has been developed and applied to the formation of iron oxide slime coatings on quartz and on corundum. It is shown that recovery in flotation is related to the density of the slime coating and that a maximum density of about 50 per cent of the surface was found with quartz in the presence of the collector, and somewhat lower when no collector was present. In the case of corundum, the percentage area which was slime coated was considerably less.

The charge at the surface of the three oxide minerals used is controlled by the pH of the solution. Silica, iron oxide, and alumina, are negatively charged at pH values greater than 3.7, 8.0, and 9.5 respectively, and are positively at pH values lower than these values, so that the slime coating would be expected to be heaviest under conditions in which the slime is uncharged or is charged oppositely to the mineral. This would indicate that the densest coating of iron oxide slime on quartz should occur in solutions near neutral and the coating density should decrease as the pH becomes acidic or basic.

Similarly, the heaviest coating should occur on corundum at a pH when the minerals are oppositely charged, namely, between 8 and 9, and since the isoelectric point of iron oxide and alumina differ by only 1.5 pH units, the coating should be less than on silica. Experiments have shown this to be the case, and the correlation between surface coating formation and the surface charge is an inviting subject for further study.

REDUCING SCREEN BLINDING

As most operators know to their cost, blinding of screens can be not only costly but also a serious contributory factor to lower throughput and inefficient operation.

Blinding is generally due to one of three easily ascertained causes: improper operating characteristics of a vibrating screen, moisture, and irregular-shaped particles.

Unfortunately the writer (J. E. Fink, *E.M.J.*, Vol. 159, No. 12) does not deal with the first factor other than stressing the importance of consulting the manufacturers and pointing out that larger amplitude of motion can be correlated to larger screen surface openings. A useful table is given showing this relation as well as slope and direction of rotation.

As far as moisture is concerned as a cause of screen blinding, the common means of alleviating the trouble are fitting screen surfaces with rectangular openings, heating by passing a low-voltage current through the screen cloth and employing rubber balls to jar the screen from underneath. Frequently more drastic methods may be necessary if the screen opening is large, viz. larger than ¼ in., when the electrical methods require an excessively large current and the mass of ball necessary to produce secondary vibration by impact becomes unreasonably large.

In such cases one can only resort to long slotted openings or flame heating by providing a long flame from a gas or oil burner either parallel to or at a slight angle to the underside of the screen surface. Such heaters, however, usually require some cooling device for the screen mechanism.

For machines handling material under ¼ in., it is often possible to keep the screen cloth clear by means of the impact of rubber balls on the underside. In the case of large screen openings, the use of perforated plate instead of wire-woven screens is suggested, as the opening cannot spring open to receive such particles, although exceptionally elongated particles can get in such perforation and are not dislodged by vibration, even though they are not wedged into place. More force is required to throw elongated particles out of the screen than when more equidimensional particles are being handled. This force can be obtained either by increasing the speed or the amplitude of vibration, but the latter appears to be more effective.

FILTERING FINE COPPER PULP

The filtration of slimy material is frequently troublesome, and this difficulty was anticipated during the designing of the 10,000 tons per day plant of the White Pine Copper Co., in Michigan.

Preliminary work with ordinary rotary filters having scraper discharge led to cloth blinding, whilst the amount of blow-back necessary led to an appreciable quantity of filtrate in the filter cake, with the discharge of too wet a cake.

With string discharges together with compression blanket rollers, filtration was greatly improved, yielding a cake with only 16 to 17 per cent water and two filters (one as a standby) were installed instead of ten ordinary units as originally contemplated.

Using 4 oz. nylon medium supported by a coarse-mesh backing cloth and nylon strings on ½ in. centres, normal filtering rate is about 60 lb. per sq. ft. per hour.

Maintenance is said to be below average, filter cloths last approximately six months, compression belts one year, and string replacement is no more than two spools per month.

Machinery and Equipment

Pumping Clean Mine Water

The Dolphin floating suction strainer, developed and produced by Megator Pumps and Compressors Ltd., is claimed to meet a long-standing need by users of pumps that draw from sumps or are employed for de-watering mines, quarries and excavations of all types. The Dolphin was shown to the Technical Press on Tuesday of last week.

The problem is to draw the water from just below the surface so as to avoid drawing in either sand or silt from the bottom or floating matter from the surface. Another problem to which the Dolphin strainer promises a solution is the tendency for air to be entrained into the pump suction due to vortex formation. In the case of an ordinary centrifugal pump this phenomenon can, and frequently does, put the pump completely out of action. Experience to date has indicated that the Dolphin strainer prevents the formation of vortices, first by reason of the cylindrical disposition of the entry holes, and secondly, because any tendency to vortex formation is automatically countered by a slight sinking of the strainer so that a vortex-free position of equilibrium is established.

The ordinary type of strainer, which sinks to the bottom, not only allows fine solids to be drawn into a pump, causing a considerable amount of wear, but owing to its weight it invariably gets buried, sometimes completely, and, blocking the suction line, produces cavitation erosion—a frequent cause of trouble which adds to the high maintenance costs of pumps engaged on this type of rugged application.

The Dolphin strainer is light, compact, and convenient, and readily fitted to the end of the suction hose. It is made in four sizes, for 1½ in., 2 in., 3 in., and 4 in. hoses. It stands both as an auxiliary equipment to the Megator range of pumps and as a unit in its own right, as it can be incorporated in any pumping system. The result of fourteen years of development, the Dolphin will be marketed through the normal Megator channels.

One of the difficulties in any attempt to combine a strainer with a float that sustains the weight of the hose is that the twisting action of the hose tends to turn the strainer out of its correct position or invert it altogether. In the Dolphin design, on which world-wide patents are granted or pending, this difficulty is overcome by correct analysis of the balance and buoyancy of the parts, and by the original feature that the tube to which the hose is directly attached can rotate freely in the body of the strainer. The float chamber is filled with a moulding of expanded polystyrene "foam", which provides millions of separate water-tight air cells so that buoyancy cannot be lost as a result of accidental damage.

The design of the Dolphin strainer is also ideally suited to conditions where there is not sufficient depth of water for it to float, as, for example, in mines and excavations where the object is to keep the water as low as possible, and where, in other words, the pump is working under "snore" conditions. Under these conditions, it still tends to keep its upright position regardless of twisting of the hose, and as the bottom of the strainer is flat and all the entry holes are in the sides, and as, moreover, the strainer is extremely light, there is no tendency for it to sink or to be sucked down into the sand or silt on which it may be resting.

The entire strainer is constructed from tough, resilient plastics and austenitic stainless steel, so that it is for most practical purposes immune from corrosion. The strainer is able to withstand rough handling, and its rounded shape, flat bottom, and freedom from projections, make it well adapted to being hauled about on the end of the hose.

REFINING SPECIAL METALS

The first commercial installation of an electron beam furnace to melt, refine, and cast special metals will be made this spring by Wah Chang Corporation at its Albany, U.S., plant. The furnace, to be designed and built by Stauffer-Temescal Company, will have a 225 kW. rating and will be capable of the continuous melting and casting of high-purity ingots, 6 in. in dia. and 4 ft. in length, of such refractory metals as columbium.

The novel electron beam furnace was developed by Stauffer-Temescal Company. They have successfully melted such metals as tungsten, molybdenum, tantalum, columbium, hafnium, zirconium, uranium, beryllium, special steels, and rare earth metals. Electron beam refining broadens metallurgical horizons for the commercial production of ultra-pure reactive metals because it combines the advantageous features of ultra-high vacuum and of direct heating by electron bombardment.

Wah Chang Corporation, one of the leading refiners of tungsten and kindred metals in the United States, has been licensed by Stauffer Chemical Company to operate the electron beam furnace on a commercial scale.

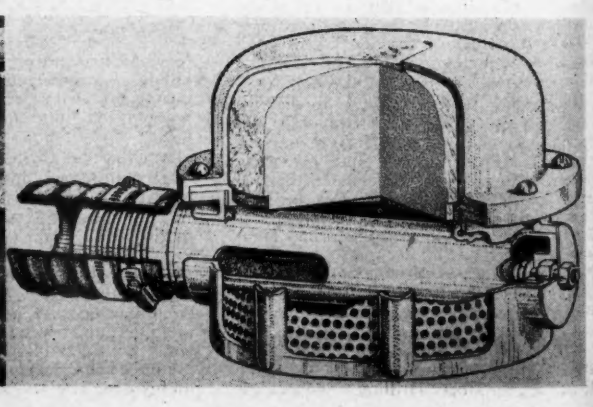
REMOTELY CONTROLLED CONTINUOUS MINING SYSTEM

A mining system permitting men to mine coal without going underground has been announced. Joy Mfg. Co. and Union Carbide Corp. have jointly announced the signing of an agreement that gives Joy the right to manufacture, use, lease and sell a remotely controlled continuous mining system. This equipment was originally developed by Union Carbide Olefins Co., a division of Union Carbide Corp.

Peabody Coal Co., St. Louis, Mo., operated one of the early Carbide-built prototype machines for several months in three of their mines. Final commercial development of these machines is now being undertaken by Joy, on completion of which Peabody expects to place the first commercial machines in operation. According to Joy's president, W. L. Wearly, this is expected to be in about 18 months.

The system is operated by a man at an electronic control centre, actuating the mining machine which can penetrate high-wall coal to a depth of 1,000 ft. or more. The continuous mining machine is equipped with sensing elements which electronically report to the operator outside the mine whether the machine is properly heading into coal. With this information the operator outside the mine electronically guides the course of the machine to follow the coal seam. A

The Dolphin floating suction strainer. At left, the strainer working under snore conditions in a coal mine. At right, a cutaway view of the equipment showing the main design features.



Portable hydraulic power has been adopted as a method of pit tub straightening by several collieries in the North following its successful introduction at Eden Colliery, Durham. The use of hydraulics completely eliminates the heavy hammering which was previously required to repair even the least damaged tub. Blackhawk Porto-Power hydraulic equipment is used on the job. It includes the Porto-Power 10-ton long-stroke ram and pump. This equipment forms the basis of general purpose equipment and may be used also for lifting, bending and spreading, and for 3-leg pulling gear for wheels and couplings

prototype machine reportedly has proved capable of advancing an entry at a rate of more than 100 ft. in one hour.

The mining machine automatically loads coal on to a heavy-duty continuous transport system that follows the machine into the mine and delivers the coal to an outside discharge station. This transportation system is said to be designed to operate in conditions where local roof falls may occur.

Joy is proceeding with the final commercial development of the machine, with the advice and assistance of Union Carbide, at a special department established for this purpose at Joy's Coal Machinery Division at Franklin, Pa.

Both Peabody and Joy believe that this patented system is of great importance to the recovery of high-wall coal and that it will eventually have a substantial impact on the future of the coal industry.

CRUSHING PLANT FOR NIGERIA

Following the successful operation of a Dixie Hammermill plant for crushing shale at the Cauldron Cement Works, an order has been placed with the Fraser and Chalmers Engineering Works of the General Electric Co. Ltd., at Erith, for the supply of a similar plant with larger units for the new Western Nigerian Cement Works of the Blue Circle Group of Associated Portland Cement Manufacturers Ltd.

The rock to be crushed is a sticky mixture of limestone interbedded with marl and clay with lumps up to 36 in. in size. The input will be at the rate of 200 tons an hour, and a product containing 85 per cent of material less than 1 in. in size is required. The crushing plant will comprise a feed hopper, a variable-speed inclined apron feeder, 72 in. wide by 21 ft. 6 in. long, and a Dixie Non-Clog Hammermill, size No. 6060, with the necessary chutes and discharge hoppers. All the plant will be housed in a suitable building.

ALUMINIUM PROTECTS TUNNEL ARCH

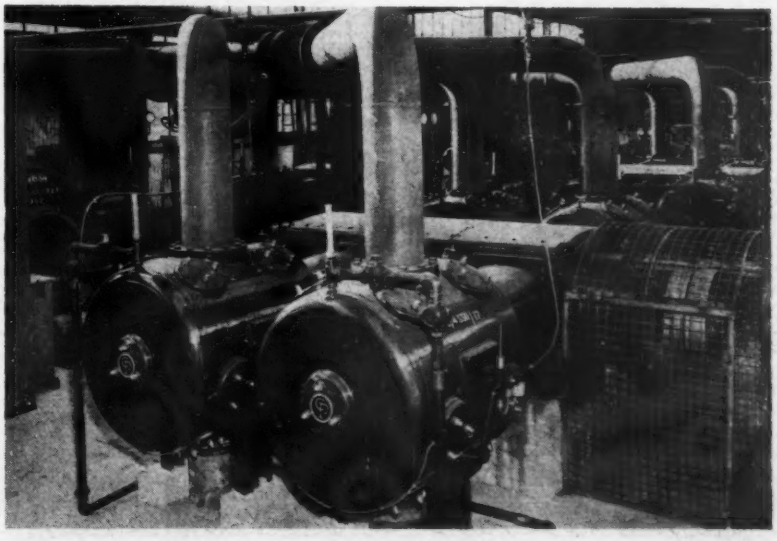
Aluminium rock bolts are being used successfully in the driving of the 50 ft. dia. discharge tunnel of Alcan's 1,000,000 h.p. Chute-des-Passes hydro-electric project in Northern Quebec. In addition to safeguarding excavation crews against falling rock, they will provide permanent protection for the completed tunnel.

The unlined tunnel is being driven through broken and jointed rock which, for a large percentage of the distance, is not strong enough to form a secure arch without strengthening. Dependable protection of steel bolts to prevent future corrosion is difficult and expensive, especially where full concrete lining is not used.

The high resistance to corrosion offered by aluminium, together with its strength, makes it attractive for this use. Its light weight is an added advantage in handling and placing.

The normal aluminium rock bolts are made of Alcan 65ST alloy 1¼ in. round bar stock. One end is threaded. On the other a wedging device is forged. Bolts vary from 6 ft. to 12 ft. long depending on rock formation. The wedge end is inserted into a hole drilled into the rock. An aluminium nut, bearing against an aluminium washer 8 in. x 8 in. x ¼ in., pulls the bolt out of the hole until the wedges secure it. The bolt is then tightened, compressing the irregular surfaces of the rock together so the rock roof itself acts as a curved beam. The high elastic limit of Alcan 65ST alloy makes the aluminium bolt about as effective as steel, with the additional advantage it does not rust.

The 8,500 aluminium bolts, washers and nuts required to protect the tunnel arch will weigh about 60 tons. None of the grouting or other corrosion protection required for conventional rock bolts will be needed.



With a rated maximum capacity of 28,610 cu. ft. per minute, free air delivery, at a pressure of 40 lb./sq. in., for tunnel pressurization, and 2,720 c.f.m., F.A.D., at 125 p.s.i., for the operation of power tools, the battery of electrically-operated compressors installed by Charles Brand and Son Ltd. at the site of Glasgow Corporation's Clyde tunnel is one of the largest of its kind ever installed for a compressed air tunnel. The low pressure air is derived from an installation of four Consolidated Pneumatic class F.E. balanced opposed compressors, three Alley MacLellan series 56 balanced opposed compressors and six Consolidated Pneumatic type T.B. compressors, all single-stage machines

MINING MISCELLANY

An experimental plant for the production of gallium has begun test runs at Ajika, in eastern Hungary. The gallium is recovered from the caustic solution used in the extraction of alumina.

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A titanium plant with a capacity of 16,000 tonnes annually is to be set up at Björneberg, in Finland. The scheme is backed by a group of Finnish industrialists.

★

A report from Cairo states that, having discovered commercial deposits of copper in the Abu Hamsh, Abu Sueil, Umm Sambuki, and Aswan areas and in the Sinai peninsula, the United Arab Republic is to build a copper refinery in the near future. The plant will have a throughput of 300,000 tonnes of ore and a production capacity of some 10,000 tonnes of refined copper.

★

Geological research in the Irkutsk area of Eastern Siberia is being organized on a large scale, states *Pravda*. Last year, some 20,000 volunteers were assisting the geologists. One of the volunteers discovered a large manganese ore deposit near Korotkovo, in the district of Kirensk north of Lake Baikal, which is regarded as very promising.

★

It has been announced that Pickands Mather and Co., of Cleveland, have agreed to pay Canadian Javelin $28,500,000 for a 10 per cent stock interest in Wabash Iron Ore Co. and Wabash Lake Railway in Labrador. Javelin will also receive royalties on a rising scale that will reach an irreducible minimum of $5,000,000 a year, whether Pickands Mather mines the Labrador ore deposits or not. Pickands Mather has also agreed to complete the 42-mile Wabash Lake railway.

★

The second annual report of the International Tin Council for the year to June 30, 1958 (24 pages, 7s. 6d. post free) covers a period of important events for tin producers and tin consumers. During the whole year the buffer stock manager was buying tin, particularly after the market price touched in October, 1957, the floor price in the Agreement. By the middle of 1958 the buffer stock had reached 23,300 tons of tin. The control of exports from producing countries in the Agreement was first put into operation on December 15, 1957. The report contains the buffer stock accounts, showing the contributions of each producing member, an income for the year of £17,140,000 and an expenditure of £72,000.

★

Three Dutch firms and one American company—so far unnamed—are to explore for and exploit nickel, cobalt and iron ore deposits in Dutch New Guinea, following agreement with the Dutch Ministry of Overseas Affairs on contractual conditions. The concession involves the island of Waigeo and the Cyclops Mountains where important finds have already been made.

★

The first section of a new Soviet concentrating plant has been completed near the large copper deposits of Sibai in Bashkiria, reports the *Industrial and Economic Gazette*. Apart from copper concentrates, the new plant will provide zinc and sulphur concentrates.

★

Mr. S. Ambash, head of the Ambash Engineering Corporation, is understood to have proposed to the Israeli authorities to set up a copper refinery with an initial capital of I£4,000,000. Plans and designs are now being examined. The raw material would be copper pyrites imported from Cyprus, where the Ambash company is reported to hold a concession.

★

Two German geologists have made recommendations, accepted by the government, for the improved operation of the gold mines in El Oro, Ecuador.

★

A $478,574 road to carry iron ore from the central mountain range of the Dominican Republic at Hatillo is due for completion in April, 1959. Earthmoving operations have been completed as far as El Mogote, where additional ore deposits have recently been discovered.

★

A large-scale research on the possibility of copper extraction is still in progress in French West Africa and a number of fairly small successes have been recorded in the area of Akjoujt. Parallel, and so far unrewarding, searches for water supplies for the treatment of mineral ores are also going on in the Akjoujt basin. It is estimated that a pilot plant for treating the ore would, if developed, require 6,000 cu. m. a day.

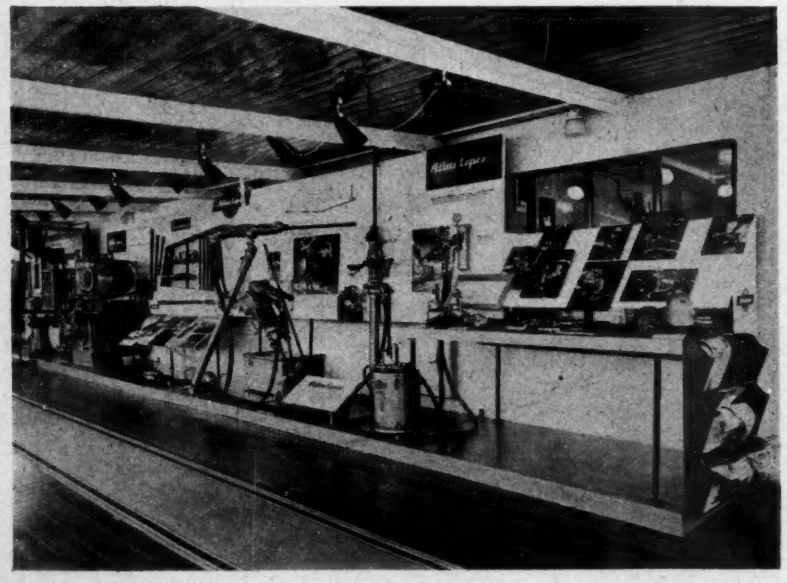
★

The Niger territory, hitherto neglected by geological research in comparison with other territories in French West Africa (largely because of inaccessibility), is now receiving more attention. Searches are being made, although on a small scale and as yet without support of public funds, for deposits of tin, copper and oil. Small quantities of cassiterite have been produced during the past ten years and also a little wolfram. Shortage of water has proved a great obstacle in treating the cassiterite, which is regarded as the most promising mineral in this territory.

★

Kennecott Copper Corporation is to spend about $90,000,000 this year. This is part of a $172,000,000 programme initiated in 1958 for the integration of copper producing facilities, expansion and other projects principally at its mining properties in the western states. The programme includes provision for new mine facilities at the Ray Copper Mine in Arizona, increased power facilities both at the Utah Mine at Bingham Canyon in Utah, and the Chino Mine in New Mexico. It also involves the acquisition of the mining properties of Consolidated Copper Mines Corporation, adjacent to Kennecott's Nevada mines, for about $8,400,000, as well as a new $30,000,000 electrolytic copper refinery in Arundel County, Maryland, scheduled to being in operation in August this year. The integration programme also includes the acquisition in January, for about $20,000,000, of the Garfield Utah copper smelter from the American Smelting and Refining Co.

Amongst the 250 Swedish companies which exhibited in the floating exhibition by the General Export Association of Sweden, was Atlas Copco A.B. who, in fact, had the largest stand on board, and showed a comprehensive display of their equipment ranging from an AR1 stationary compressor and the T2G mine loader to small tools. The photograph shows the Atlas Copco stand on M.S. "Elgaren". The vessel has recently returned from a tour of South and East African ports. The project is discussed on page 193



Nearly six miles (9,000 metres) of rubber-covered conveyor belting designed and manufactured by BTR Industries Ltd.—some of it almost certainly the widest and thickest ever made—is now on its way to a large ore field in the Soviet Union. The contract was obtained against world competition and was completed on schedule within three months. This vast Soviet conveyor installation is believed to be unique in demanding belting of exceptional width designed to standards never before attained—and in that it is the first application of 100 per cent 'Terylene' fabric in a major conveying system. The special heavy fabric was woven to BTR design from 376,000 lb. of 'Terylene' yarn. The belting has been supplied in three widths: 1,400 mm. (55¼ in.), 1,600 mm. (63 in.) and 2,000 mm. (78¾ in.) and shipped in fifty rolls each about 180 metres (590 ft.) long. It is made up of 8 to 14 plies of 'Terylene' fabric with skim coats between plies—the widest belting with a 6 mm. thick top cover including a nylon transcord breaker and a 2 mm. thick back cover. The maximum working tension in the wide belting is 60,000 kg. (59 tons) and is capable of transmitting in excess of 1,000 h.p.

PERSONAL

After over thirty years' service with North Broken Hill Ltd., Mr. W. R. Miller, assistant manager at Broken Hill, New South Wales, will retire on March 2, 1959. The following consequential appointments have been announced by North Broken Hill Ltd.: Mr. W. E. Fitzpatrick as deputy-manager, Broken Hill; Mr. J. R. Finlay as Operations Manager, Broken Hill; Mr. A. Silver as deputy-operations manager, Broken Hill.

★

Mr. Walter Vivian Douglas Skrine has been appointed a director of Kepong Dredging Co. Ltd.

★

Mr. J. R. Bradfield, president of Noranda Mines, has been elected president of the Canadian Metal Mining Association in succession to Mr. J. B. Redpath, executive vice-president of Dome Mines.

★

Mr. F. G. Charlesworth has been appointed a director of the British Tin Investment Corporation Ltd.

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Mr. James Hodge has been appointed to the newly created post of chief engineer to the Holman Group. This appointment will result in the co-ordination of all research, design, and development work throughout the companies of the group.

★

Sir John Dean has been appointed a director of British Insulated Callender's Cables Ltd.

★

Mr. John Dryburgh has been elected a director of Kalgoorlie Electric Power and Lighting Corporation Ltd.

★

Mr. J. E. C. Bailey, chairman and managing director of Baird and Tatlock (London) Ltd., and Hopkin and Williams Ltd., left the United Kingdom recently for a short tour of Uganda, Kenya, Northern Rhodesia, Southern Rhodesia, and South Africa. He will visit the companies' branches, agents, and representatives in these countries. While in Northern Rhodesia he will visit a new branch of the companies at Ndola, the opening of which will facilitate handling of the increasing volume of orders from the Copperbelt.

★

Mr. W. Wanstall has been appointed sales and technical service representative by Chloride Batteries Ltd. to cover the territories of East and West Africa.

★

British Insulated Callender's Cables Ltd. have announced the appointment of Mr. C. S. F. Lane as regional manager for Australia and New Zealand in the overseas organization in London. He succeeds Mr. R. H. Semple, who has taken up a senior executive post with an associate company in Australia.

★

As from March 6, the address of Jacobs Metals Ltd. will be Caroline House, 55-57 High Holborn, London, W.C.1. Phone: Holborn 1971. Telex: 28655. Cables: METALJACOB London.

AGENCIES WANTED

Mr. E. A. Westfried, president of Huxley-Westfried Corp., 350 Fifth Avenue, New York 1, N.Y., wishes to establish connections with U.K. firms exporting the following minerals: Chrome ore (metallurgical, refractory and chemical); manganese (high grade); mica bridges, washers, discs, etc., for electronic field; columbite; tantalite (min. 20 per cent TA_2O_5). Exporters interested should write by airmail direct to Mr. Westfried, quoting both f.o.b. and c.i.f. prices in U.S. currency. Copies of the initial correspondence to the British Consulate-General, Commercial Section 99 Park Avenue, New York 16, N.Y. B.O.T. Ref.: ESB/28722/58. Telephone enquiries to Chancery 4411, extension 776 or 866.

CONTRACTS AND TENDERS

India

Design and execution of a complete aerial ropeway system (*vide The Mining Journal*, January 23, 1959, p. 98). The Export Services Branch has been advised that the closing date has been postponed to March 16, 1959, and tenderers have been requested to keep their offers open for consideration up to September 16, 1959. B.O.T. Ref.: ESB/31903/58.

★

Large orders for battery equipment have been received by NIFE Batteries Ltd., at Redditch, for the £100,000,000 steelworks which is being constructed at Durgapur, in the Damodar Valley, West Bengal.

Mining Machinery Exhibition

The Rt. Hon. Lord Mills, K.B.E., Minister of Power, will open the Mining Machinery Exhibition at Olympia, London, on Thursday, July 9. The Minister will also be the principal guest of the Council of Underground Machinery Manufacturers, the sponsors of the Exhibition, at the official luncheon to be held immediately after the opening ceremony at noon.

The following are additions to the list of exhibitors published in our issue of January 16, 1959, page 70:

Greenwood and Batley Ltd., Albion Works, Armley, Leeds; Markham and Co., Ltd., Broad Oaks Works, Chesterfield; Metropolitan-Vickers Electrical Co., Ltd., Manchester, 17; Mining Journal, 15 Wilson Street, London, E.C.2; Norton's-Tividale Ltd., Tividale, Tipton, Staffordshire; G. E. Simm (Engineering) Ltd., 27 Broomgrove Road, Sheffield.

The number of exhibitors at this ten-day show has now reached a total of 96. Their comprehensive display of machinery and equipment will include:—

Drilling machines, drill steels and bits, bursters and shotfiring equipment, coal-cutting machines, mechanical picks, coal-ploughs, power-loading machines, dumpers.

Conveyors, conveyor belting, belt-lacing machines, underground locomotives, mine-cars and mine-car handling equipment; wire ropes and aerial ropeways; winders, winches and hoists.

Roof-supports, props, chocks and arches; stowing machines; hydraulic face-support systems; pumps; fans and ventilation equipment; lighting equipment; signalling and communication systems.

Fire-fighting equipment; fire-proofing and timber preservation; gas detection; dust suppression and water infusion equipment; safety clothing.

Electric motors, switchgear and batteries, cable and cable connections; compressors; hydraulic power packs; hose and hose fittings, valves.

Symposium Additions

Two more papers have been added to the Symposium on Shaft Sinking and Tunnelling, arranged by the Institution of Mining Engineers in conjunction with the exhibition authorities. These additional papers, which brings the total to 21, will be read by Belgian mining engineers. (The titles are not yet known.)

The Copper Industry: Some Factors Affecting Its Future

It is probable that the greatest single cause contributing to the wide price fluctuations common to most metals is a lack of reliable statistical data, not only with regard to present stock positions and supply/demand trends, but equally to the projection of these trends into the future. Moreover, there are as yet no signs of the establishment of a world-wide statistical service which could maintain Paley-type projections, progressively revised in the light of changing circumstances. Meanwhile, so far as copper is concerned, this very necessary service has of late been ably performed by Sir Ronald L. Prain and the statistical team in his R.S.T. group of companies. Sir Ronald delivered the most recent of his periodic projections in an address to members of the Mining Club of New York on February 4. We give here the full text of this address.

DURING the past two years or so our Companies have made a number of separate studies dealing with different aspects concerning the future of the copper industry. I fully realize that many others in the copper industry are undoubtedly making their own studies on these same matters, and we therefore claim no exclusiveness in these researches. I offer you some of our conclusions in order to stimulate discussion and to give others an opportunity to tell us where they think we may be wrong.

May I also say at the outset that I fully realize the danger that an address like this will be treated as a piece of crystal-gazing. I have to accept this risk of misunderstanding, but I believe you will all here realize that it is not a matter so much of crystal-gazing as of trying to make estimates of what might occur in certain respects and in certain circumstances, based on the experience of the past. My picture is not intended to present the short view or the very long, but to examine the middle distance.

I shall start by summarizing our views and tentative conclusions as follows, and then I will go back and deal with each heading separately.

Price Levels

1. Copper appears to have a most promising future and growth factor provided, however, that the price is not allowed to go above certain levels.

2. If the price is allowed to exceed these substitution points for any length of time, consumption will begin to be increasingly affected and production excesses will occur on an increasing scale.

3. If the price, on the other hand, is allowed to go below certain levels for any length of time, new productions may not be forthcoming on the scale which the normal growth factor will require, and thus production shortages will begin to appear.

Stability

4. In the absence of any planning by the industry, the usual laws of supply and demand will take care of the situation in the future as they have done in the past. That is to say, increases in price will carry in them the seeds of recession, and falls in the price of copper will carry in them the seeds of recovery. But the time-lag which occurs before these laws come into full operation will mean, unless the industry has some plans, that we shall see the usual large price fluctuations occurring again in future, and we question whether, in view of some new factors in the copper situation, consumers will tolerate such behaviour as readily in the future as in the past.

5. For this reason the copper industry would be well advised to adopt production policies designed not only to damp down these excessive fluctuations, but to apply corrective measures with a greater rapidity than can be done by the laws of supply and demand unaccompanied by deliberate action. The regulation policy I have in mind is curtailment on a voluntary basis by the mining industry if consumption is falling, and the complementary act of increasing production when consumption picks up again.

Expansion of Production

6. Assuming that by such methods price fluctuations are kept within limits, and the maximum price of copper kept within bounds which will not encourage substitution, the indicated growth factor is such that it should permit the bringing into production of most of the known ore reserves within the next decade.

7. The increases in capacity which are presently planned will mean a net 15 per cent increase in mine capacity between the years 1957 and 1962, with no appreciable increase in either the average cost of production or the maximum cost.

Exploration and Investment

8. The discovery rate of ore reserves as established during the last forty years will have to be increased during the next decade to cater for the projected growth rate of consumption, that is to say, to create the necessary additional production in the second decade after this.

9. Based on these projections, the capital investment in the copper industry between 1957 and 1970, including projects now under development, might be as much as $3,000,000,000 on the basis of present monetary values.

I shall now go back and amplify some of these tentative conclusions.

Future Demand

The first one dealt with the prospects for the future consumption of copper. There are various methods which are employed or can be employed for arriving at estimates of future consumption of this metal. We have examined most of the known methods and have arrived at some estimates which represent approximately the average result produced by these methods. I will not define these as I am not an economist or a statistician, and I do not want to get involved in a discussion as to methods. I can, however, say that we have worked along the following lines and with the following results.

(*a*) Historically, the growth of world copper consumption from 1880 to the end of World War I averaged between 5 and 6 per cent per annum, then slowed down to under 2 per cent per annum in the inter-war era. Since 1946 the growth has averaged nearly 4 per cent per annum.

(*b*) Free World consumption of refined copper appears to bear a close relationship to real national income, which, broadly speaking, is population multiplied by standard of living.

(*c*) Whilst this is true of refined consumption in the Free World as a whole, the situation in the United States differs from that in the non-dollar countries of the Free World. In the United States growth in refined copper consumption has not kept pace with that of general economic growth, the post-war loss against real national income in the dollar area having averaged 2.6 per cent per annum. In the non-dollar countries of the Free World, growth of refined copper consumption has been faster than that of real national income; we would expect this trend to continue for some more years, after which growth in consumption may become slower than that of real national income.

(*d*) We have reduced estimated total Free World refined consumption to a demand for primary metal by subtracting copper which may be expected to come from secondary sources. We examined three different methods commonly used for estimating production from scrap, and found two of them, when projected, gave almost identical answers, and it is the projections given by these two methods that we have used for subtraction purposes.

We do not think that any of the three methods of projecting secondary production is ideal, and we suggest that there remains considerable room for research on the subject of statistics on scrap, both new and old.

(*e*) The result of these studies shows that the demand for primary copper might increase from about 3,500,000 tons in 1960 to about 5,000,000 tons in 1970.

I hesitate to reduce to figures any opinion as to demand after 1970, but it is, I think, admissible to say that the growth factor, based on the expected growth of Free World real income, and adjusted for various factors which I need not enumerate here, continues to show a rising trend during the decade 1970-80.

If I say much more under this heading, I shall get involved in the classical arguments which economists get involved

in, so I will sum up this part by saying that we may expect an increase in annual demand for primary copper between 1960 and 1970 of over 1,500,000 tons, provided there is no abnormal increase in substitution by other materials, thereafter we may expect demand to continue to rise.

The "Right" Price—

Turning now to (2) of my summary, I do not myself believe that the price of copper is high. The decrease in the value of money has given us a distorted impression of the price of copper. I recently made a study of the sterling price of copper for each year of the last hundred years, and I converted the average price of each year into constant values in terms of the price of gold of the year 1858. This study showed that in terms of such constant values, the price of copper in 1958 has been exceeded in no less than forty-one years out of the last hundred years.

This might again get me involved with the economists, but I mention it to show that, in my opinion, the price of copper is not excessive, and the real problem for the copper market has arisen from the fact that it is only in the last quarter-century, and particularly since World War II, that copper has had increasingly to face a new feature which hardly existed previously, namely: the possibility of substitution by other materials.

—In Relation to Substitution

These materials are well known to this audience and I will not spend time on them. I will confine myself to saying that there is no question that this threat is real, and that it has begun to impose an entirely new discipline on the behaviour of the copper market, and will do so increasingly from now on into the future. It is this factor which demands a re-assessment of the top price that copper can reach with impunity, and we are slowly beginning to learn something about this.

In particular, I refer to the deliberations of the International Wrought Non-Ferrous Metals Council, which is a European organization consisting of representatives of most of the fabricators of all European countries except Spain. This Council has been meeting regularly for years, and more recently has instituted bi-annual meetings with representatives of any copper mining producers who care to attend. As a result I believe that the consumers of Europe today are becoming more aware of some of the economic facts of life affecting the mine production of copper; while the producers who attend these meetings are hoping to learn more about the substitution points experienced by these fabricators, who incidentally represent a copper fabricating capacity of over 2,000,000 tons a year.

The first, and on the whole elementary, conclusion that can be reached from the preliminary work of this council is that it is dangerous to talk of any one substitution point for copper. This point varies from use to use (and we all know there are many thousands of uses for copper), and it also varies from country to country, since the price of copper, the price of labour, and the price of substitutes are not the same in each country.

Furthermore, even if you could establish specific substitution points for each product for each country, this would not be the end of the exercise, since there is at work a constant process of change in the price relationships between copper and its competitors.

Views of European Fabricators

For these reasons it is difficult to do more than arrive at generalizations. A start has just been made by the International Council to get authoritative generalizations, and I can indicate to you, with the permission of the council, some of the preliminary findings.

Returns were made by five countries, namely: Austria, Great Britain, Italy, Sweden, and Switzerland, based on prices of £150 per ton, £200, £250, and so on at £50 intervals up to £400 per ton. In cents per lb., this represents a range of about 20 to 50 cents. The generalizations to date appear to be as follows, based on present price relationships and monetary values:

(*a*) Very little substitution occurs below and up to the price of £250 per ton, i.e. 31¼ cents per lb.

(*b*) Above that point consumption of copper begins to fall off faster. Returns for these five countries show that at a price of 50 cents per lb. consumption of copper will be about 70 per cent of what it is at 31¼ cents (or 65 per cent of what it might be at 20 cents a lb).

(*c*) This composite result is arrived at from a study of various sections of the industry, all of which show a different experience factor. For instance, consumption of rolled metal appears to be by far the most vulnerable as prices go up. The decrease in consumption between 20 cents and 50 cents a lb. is about 45 per cent. The consumption of rods and sections and of wire is less vulnerable, being about 30 per cent down between the same prices, while it appears that the least vulnerable is the consumption of copper and copper alloy tubes, which shows a 25 per cent decrease over the same price range.

(*d*) The consumption of wire does not appear to be seriously affected until the price of copper rises to 40 cents a lb.

Improving Europe's Statistics

These statistics are now being improved upon by the inclusion of further countries and products, and it is hoped to maintain them in an up-to-date form which will take continuous account of changes in the price of substitutes and of monetary values. It would be interesting to know how experience in the United States compares with experience in Europe.

Before leaving the question of the International Council, I might mention another valuable study now being developed, which is a return by all the fabricators in these European countries of orders booked by them for the sale of their copper products. This will be expressed as a composite index figure, taking the period January to June, 1958, as 100. It is hoped in this way to arrive at a new statistical service which will show at relatively short notice what is occurring in actual copper business being booked at any one time in Europe. If this can be developed successfully, it should fill an important gap in our present statistical services, most of which suffer from a time-lag due to the fact that they are based on movements of physical raw copper months after business in copper products is actually booked.

Price Required to Sustain Production

Turning now to items (3) and (7) of my opening summary, both of which dealt with copper production, it follows that if the price were to go too low, the production necessary to satisfy an increasing consumption might not be forthcoming. We have made an elaborate study of the projected Free World primary copper capacity through 1962, and without going into details of the basis on which we worked, I can say that our estimate shows that Free World primary capacity, which in 1957 was 3,600,000 tons, is expected to rise to 4,200,000 tons in 1962.

But the interesting point of this study arises from our estimates as to the cost of production, and in particular the average cost of production. In 1957, this average cost was 18½ c. per lb. and our estimates show that it is unlikely to rise above 19 c. per lb. by 1962. If this estimate proves to be valid, it is an important conclusion.

As regards the upper range of estimated production costs, we figure that in 1957 the amount of copper produced at a cost of 30 c. per lb. or less totalled about 3,300,000 tons, while in 1962 the expected capacity at or below the same cost, 30 c., is just over 4,000,000 tons. In other words, practically the whole increase in the next few years may be achieved at a cost not exceeding 30 c. per lb. with not more than ½ c. increase in the average cost.

I should emphasize that we have not taken into account in these calculations any further decline in the purchasing power of currencies. The weighted average cost which I have quoted is that of electrolytic copper delivered buyers after crediting by-products and after including depreciation. It does not, however, include income taxes, interest on loans, or amortization of borrowed capital, and finally, I emphasize that the figures I have given are estimated costs and not copper prices.

Since the mining of copper over any long period must show a return to the investors, it would be in line with economic history that the price of copper must be above the average cost of producing it and in most years above the cost of the marginal production. On the interesting theory which has been evolved by your distinguished member, Mr. Arthur Notman (the so-called Notman formula, which is based on the average cost of production), the figures I have given you of average cost would indicate a long-range price of copper averaging somewhere around 35 c. per lb. if it is necessary to win the tonnages I have indicated.

Self Control, Not Government Control

Turning now to items (4) and (5) of my opening summary, in which I attempted to outline the problem of maintaining a copper price which would not be so high as to encourage substitution, nor so low as to discourage production, I made a plea for the natural laws of supply and demand to be supplemented by some sort of production policy on the part of the copper industry. Please note my emphasis on the words "copper industry", because we have heard much of suggested regulation policy on the part of governments by means of commodity stocking schemes. I am person-

ally highly distrustful of such schemes operated by governments, and I prefer regulation, if it becomes necessary, by means of a production policy on the part of the industry as the best method of attempting to ensure the right price range.

One of the major problems which could concern the copper industry in future years is what happens if the substitution points should fall, while factors peculiar to the copper industry might cause the average cost of producing copper to rise in the years beyond the ones I have already referred to. This problem highlights the importance of, on the one hand, maintaining present costs of production, and on the other, the necessity for a greatly increased application of time, energy, and money to research and development so that either new uses may be found for copper, or technological advances may be achieved whereby copper might even encroach on markets at present served by other materials.

Furthermore, development policies should be co-ordinated throughout the Free World, and I am glad to think that the last two years have seen a start to this policy, which has led today to the existence of some dozen copper development organizations working throughout the Free World on parallel lines. I must however, add that in my opinion the budgets of such development associations are still far too small.

Discovery Rate is Rising—

Turning now to items (6) and (8), which dealt with ore reserves, we have made a study which I have not seen carried out elsewhere, namely: to discover what is the pattern of the discovery rate of copper reserves. The method we adopted, which is probably crude, but nevertheless a first attempt which no doubt will be improved upon by others, was to list discoveries made by decades from 1920 to the present, and to compute the estimated metal production or capacity resulting therefrom in later years. The definition of discovery date is that date at which it was recognized that an orebody would be economic and viable in the foreseeable future rather than the date of physical discovery of mineralization. This study discloses the following interesting points.

During the twenties, the average annual discovery rate was equivalent to an annual metal production capacity of 70,000 tons. The average grade, of over 3 per cent, is high by present discovery standards. In the thirties, the average grade of ore discovered was only half that of the twenties, or 1½ per cent. The annual discovery rate for the thirties was equivalent to only 9,000 tons annual production (perhaps due to the depression, which curtailed prospecting).

In the forties and the fifties to date, the average grade discovered has been about 1 per cent. The average annual discovery rate in terms of ensuing annual production or expected capacity is 38,000 tons for the forties and 100,000 tons for the fifties, with a maximum possible annual capacity at the limit of 167,000 tons for discoveries in the fifties.

—But is it Fast Enough?

I appreciate, of course, that increases in production will come from four different sources, namely: expansion to existing mines; new mines which are scheduled for production in the near future; orebodies that have already been discovered, but so far remain undeveloped; and future mines from undiscovered orebodies. I said at the outset that the indicated growth factor for copper was such that it should permit the bringing into production of most of the present known ore reserves within the next decade. In other words, we have dealt with the position of the first three of these groups.

The question I am now addressing myself to is the discovery rate necessary to take care of the situation after the existing known reserves have been put to work. If new discoveries were to cease now, it seems likely that a shortage of Free World copper production might develop in the 1970s. Continuation of the present discovery rate may be sufficient to take care of the position until about the middle 1970s, but it seems that to take care of it thereafter the discovery rate will have to be stepped up. In arriving at these estimates, we have taken account of mine depletions.

Future Capital Requirements

Turning now to the last item in my opening remarks, the capital cost for the presently planned expansions to existing mines appears to average about $850 per ton of annual production capacity of copper metal, while in the case of new mines now in the development stage this cost appears to average about $1,400. Future projects as yet unplanned may well cost more per ton of annual capacity. If we assume a requirement of 5,000,000 tons of primary copper by the year 1970, and after allowing for the mines which will decrease output or go out of production between now and then, we figure that the capital investment between now and 1970 (including projects now under development) which will be required to create the requisite capacity may be as much as $3,000,000,000.

While this figure may appear large, it should be kept in perspective against the estimated cost of creating, for instance, additional aluminium and oil capacity during the same period to achieve the production which those industries reckon they, too, will require by 1970. The figures are, I believe, several times greater for aluminium and about forty times greater for oil.

It's up to the Industry

In conclusion, it seems to me that the future of the copper industry in the next two decades will be governed to a large extent by the decisions of the industry on production policies and marketing policies; by the willingness to put research and development as a high priority; and by the skill of the geologists and prospectors in the discovery of not too costly sources of copper.

I should like to add that the opinions I have been outlining are my own and do not necessarily represent the opinions of my colleagues in Africa, England or New York. I should like to conclude by repeating what I said at the beginning, namely that nothing I have said today is intended to be crystal-gazing. My intention is implied in the title of this address, namely, to present some factors affecting the future of the copper industry. I have been dealing in factors and not necessarily in facts.

Coming Events

"Selectivity Factors in Flotation" will be discussed by the Surface Activity Group of the Society of Chemical Industry, 14 Belgrave Square, London, S.W.1, at an ordinary meeting on Monday, March 9, at 5.30 p.m. The speaker will be Dr. M. G. Fleming.

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The fifth metallurgy-ski-ing meeting organized by the School of Mining in Leoben, Austria, has been arranged to take place again this year at St. Christoph-am-Arlberg, in the Austrian Tyrol, between April 6 and 12, at the Hotel Arlberghöhe.

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"Electricity and its Contribution to the Standard of Living" is to be the theme of the 11th British Electrical Power Convention, which is to be held in Torquay from June 1 to 5, under the presidency of Mr. C. R. King, deputy chairman, Central Electricity Generating Board.

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The Purchasing Officers Association has announced that its 1959 Minibition will be held, in conjunction with the annual conference, at Folkestone from September 24 to 26.

★

French, German, British, and United States speakers will appear at the Technical Conference on Physical Metallurgy of Stress Corrosion Fracture, to be held from April 2 to 3, at the Mellon Institute, Pittsburgh, U.S.A. The programme is sponsored by the Corrosion-Resistant Metals Committee, Institute of Metals Division of the Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, and allied societies and associations.

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The annual course for laymen will be held by the Ross Institute this year from Monday to Friday, July 6-10, inclusive.

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In order to keep abreast of the demand for space in the forthcoming International Plastics Exhibition (Grand and National Halls, Olympia, London, June 17 to 27), arrangements have been made to increase the total occupied area to over 270,000 sq. ft. Attendance is expected to exceed 90,000.

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Arrangements for the next Mechanical Handling Exhibition and Materials Handling Convention are now in hand. Occupying over 500,000 sq. ft. of space, this exhibition will be held at Earls Court, London, from May 3-13, 1960. Full information can be obtained from the organizer, H. A. Collman, Mechanical Handling Exhibition, Dorset House, Stamford Street, London, S.E.1.

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The organizers of the 14th Mediterranean Fair, Palermo, June 13-29, 1959, in co-operation with the British Consulate at Palermo, are encouraging British participation by offering exhibition space, the setting up of displays, cleaning and electric current, all free of charge, in a British pavilion. B.O.T. Ref. GD/3939/58. Telephone enquiries to Chancery 4411, extension 205.

Metals and Minerals

Has Platinum Turned The Corner?

For almost two years free platinum prices in the U.K. and the U.S. have been trending persistently downwards and the official quotations of the two leading U.K. refiners have been lowered in stages to £19 10s. which compares with £34 in May, 1957. Lately there have been signs that the decline in free platinum prices has at last been arrested, but not many people can have anticipated the sudden upturn which caused the free platinum price to shoot in a few days from $48 to $60.50 in New York and from £17 10s. to £21 10s.-£22 10s. in London. In line with the higher free market prices, the official quotations for South African and Canadian platinum were raised in London by £1 15s. to £21 15s. and in New York by $5 to $57-$60.

These are the first increases in prices by the two leading refiners for about three years. They can be attributed in part to the firming up of the free market and partly to a strong industrial demand, part of which is believed to be for replenishment of depleted stocks.

The unofficial price is that paid for outside metal which is mainly of Russian origin, and the virtual withdrawal of the U.S.S.R. as a seller has consequently been a major factor in arresting the decline in free platinum prices. Offerings of Soviet platinum, which are estimated to have reached a level of up to 300,000 oz., have suddenly contracted. Various explanations have been put forward for this withdrawal, one being a shortage in Russian supplies which may have occurred, particularly if the U.S.S.R. has been running down accumulated stocks. Bearing in mind that the new Soviet seven-year plan provides for oil extraction to expand more than twofold to 240,000,000 tons, it seems reasonable to infer that in the next few years Russia's own requirements of platinum for the petroleum refining industry will be substantially increased. At the same time, the possibility that the Russians may have withdrawn only temporarily from the market in the hope of forcing up the free platinum price can certainly not be excluded.

The sudden spurt in demand during the last few days was due in part to genuine consumer buying and in part to speculative transactions. A long period of falling prices always leads to underbuying, and once the decline is arrested recovery may be accelerated by the replenishment of working stocks. This may now be happening with platinum. Speculative buying, however, has certainly been an important factor in the present upswing in platinum prices, and to this extent the outlook must be viewed with caution.

On the other hand, there can be no question but that industrial demand is now considerably better than it has been for at least a year, not only in the United States but also in the United Kingdom and on the Continent. Having regard to the improved business outlook in the United States and to the growing indications that a recovery in the United Kingdom may be expected in the second or third quarter of the current year, there are certainly good reasons for believing that platinum may have turned the corner, even if it is perhaps over-optimistic to predict a recovery on the basis of a single price increase.

It is interesting to note that, following the $5 increase by the leading refiners, platinum futures on the New York Mercantile Exchange have jumped very sharply in brisk trading. Closing for 1960 months included January at $69 traded and July at $74 traded. In view of the sharp rise in futures prices, some trade sources in New York consider that a further price increase by refiners is by no means unlikely.

U.S. MICA IN 1958

The 1958 output of sheet and scrap mineral is estimated at about 82,300 s.tons valued at $3,664,000, according to the preliminary report of the Bureau of Mines, U.S. Department of the Interior.

The Defence Minerals Exploration Administration (DMEA) programme of financial assistance for the exploration of unknown or undeveloped sources of strategic mica expired on June 30, 1958. This programme began in 1951 and during its period of operation certificates of discovery or development were issued on 66 contracts, having a total value of $484,949. Fourteen contracts were still in force on June 30, 1958. The Office of Minerals Exploration (OME), established in September, 1958, succeeded IMEA and assumed responsibility for the DMEA contracts still in force. The OME programme was activated in January, 1959. The government, through the Defence Materials Service of General Services Administration, continued to purchase domestic sheet mica for the strategic stockpile.

The tariff on all imports of unmanufactured mica, regardless of value, was greatly reduced during 1958 and, in addition, mica films and splittings not cut or stamped to dimensions were put on the free list. An increase was noted in the number of import contracts signed by G.S.A. during the last quarter of the year.

After several years of development work the International Minerals and Chemical Corporation began production in 1958 of flake mica from river silt near Greenville Tenn. This is reported to be the largest known source of flake mica in the U.S., containing more than 500,000 tons of recoverable mica, and the only operation in which mica has been commercially recovered from river silt.

TURKISH ORE EXPORTS

Turkish owners of chrome and manganese mines and exporters of chrome and manganese ores met recently at Istanbul to consider the state of the industry. They have submitted a report to the Ministry of Commerce which makes the following points:

For the past two years there has been a decline in exports of minerals—especially chrome ore. Offers made by Turkish exporters to overseas consumers have been unsuccessful. Stocks at the pitheads and railheads have continued to increase. Mine owners are no longer in a position to maintain their properties and certain mines are becoming dangerous.

The authorities are urged to incorporate clauses on exports of minerals—especially chrome ore—in all trade agreements concluded with foreign countries. They are also asked to instruct all Turkish Commercial Attachés abroad to do all they can to advance exports of minerals.

A third request is that mine owners who have invested all their capital in their undertakings should be helped by the government, so that they can continue operations.

JAPAN EXPANDS TITANIUM OUTPUT

Kobe Seike Co. has announced that in view of good domestic demand, it is to expand its installations for the production of titanium metal. The company now has capacity to produce some 10 tonnes of metal monthly and intends to raise this figure to 30 tonnes by the end of the year. Work on the new installations will begin in April and is expected to be finished by the autumn of this year.

CHROME BARTER CONTRACT

It is reported from Tokyo that four leading Japanese ferro-chrome manufacturers have concluded a one-year contract to import a total of 62,000 tonnes of chrome from the Philippines, including 10,000 tons to be imported under a barter deal against Japanese fertilizers. It is said that the import price of the ore, which is of 48 per cent quality, would be about $U.S.29 per ton, c.i.f. Japan.

ALUMINIUM AND BAUXITE

The Austrian aluminium industry has asked the Austrian Government to protect it against Soviet *bloc* "dumping" of unworked aluminium on the Austrian markets. The industry proposed that unworked aluminium imports should be made subject to special approval. It was contended that, due to increased production costs, the competitive position of Austrian virgin aluminium on the international market had worsened. On the domestic market, the home industry was in danger since the Soviet *bloc* was offering the metal at prices considerably below the world market level.

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Kaiser Aluminium and Chemical Corporation has announced a $3,000,000 expansion programme at its Trentwood rolling mill near Spokane, U.S.A. The company plans to set up an additional line to roll aluminium for the manufacture of cans. Included in the facilities will be special finishing, drying and coiling equipment.

★

The Demerara Bauxite Co. Ltd. expects 1959 to bring a modest improve-

ment in sales, reports Barclays Bank D.C.O. from British Guiana. This, however, will be offset to some degree by falling demand in the U.S. The employment position is unlikely to be affected, since the plant at Mackenzie is at present running at only 65 per cent capacity. Construction of the $60,000,000 alumina plant is proceeding on schedule and the plant is expected to go into operation in 1961. It is hoped that by that time market conditions will have improved sufficiently to take care of the full output of 220,000 tons of alumina per year.

★

Leningrad metallurgists claim to have succeeded in developing a process to produce aluminium metal with a purity of 99.99999 per cent. This so-called "seven nines" metal is made by sublimation in high vacuum apparatus and spectroscopic analysis is said to reveal only slight traces of magnesium. The method was developed by a Professor Bieliayeff. The super-purity metal is reported to be more malleable than lower-grade aluminium and to be practically non-magnetic. Uses suggested are in semi-conductors, optical equipment and in chemistry.

★

Aluminium Ltd. has announced the inauguration, by the Indian Aluminium Co. Ltd., of a new aluminium smelter at Hirakud, in Orissa State, which more than doubles India's capacity for the production of primary aluminium. The new smelter has an annual capacity of 11,200 tons of aluminium. Built at a capital cost of $10,000,000, it formed part of a $30,000,000 integrated expansion project involving bauxite, alumina, metal production and fabrication. The Indian company is considering plans to expand the Hirakud smelter to 22,400 tons capacity. Aluminium Ltd. has a 61 per cent interest in the Indian company and the remainder is held by Indian shareholders.

★

The Spanish Ministry of Industry has rejected a proposal by Aluminio Iberico to set up an aluminium refinery near Madrid. One of the major reasons given for the refusal was that Spain's foreign currency reserves were not in a state to permit the import of the equipment required. Furthermore, the Ministry said, it would be better to await completion of other projects and see whether their output would be adequate to cover Spain's industrial demand. If this was not the case, there would still be time to reconsider the rejected project. In the meantime, Aluminio Iberico is building an aluminium refinery at Vigo, in collaboration with Aluminium Ltd. of Canada.

VANADIUM IN SMOG CONTROL

Demand for Colorado vanadium may be tremendously boosted as a result of the anti-smog campaigns in Los Angeles and other cities, states *The Mining Record*. Published reports say that one of the most effective methods of controlling poisonous motor car exhaust fumes uses a vanadium-filled filter in or behind the muffler. If Los Angeles and a few other big towns legally require this smog control, new demand for vanadium might be measured in millions of pounds per year.

COPPER · TIN · LEAD · ZINC

(From Our London Metal Exchange Correspondent)

Price movements during the week have been of a very minor character and sentiment remains generally unchanged. Outside influences have also been indefinite, as both in the political and financial spheres the week has produced nothing of a definite nature.

U.S. COPPER EXPORTS ARE AGAIN RESTRICTED

The copper market in America remains firm, and during the week customs smelters have advanced their price to 30½ c. per lb., and report reasonable business at this figure. The producer's price remains at 30 c. per lb. and there is no indication that this is likely to be altered. Business in London and on the Continent has been of a routine nature, but prices were influenced in an upward direction by the action of the United States authorities in reimposing export restrictions on copper and copper products. As from February 20, individual licences will be required for each export parcel, and it is unlikely that permission will be granted for shipments of material to Russia or other satellite countries. The opinion has been expressed that this will mean that more material will be bought by Russia in Europe, and that European sellers may have to replenish their stocks for domestic use with shipments from the United States. It is also hoped that this move may mean the placing of more orders for copper rod and wire in European countries.

Adverse factors for the London market were the further increase in stocks in official warehouses and the copper statistics issued by the Copper Institute in New York. The former showed a further addition of 740 tons, making a total of 6,335 tons, and it has now been established that a percentage of this increase is, in fact, electrolytic wirebars. The Copper Institute figures for January show a slightly decreased production of refined copper at 137,361 s.tons against 146,978 s.tons in the previous month. Domestic deliveries were slightly lower at 114,425 s.tons against 116,310 s.tons in December. Stocks of refined copper were almost unchanged at 80,780 s.tons against 80,723 s.tons.

Outside the United States, production of refined copper was very slightly lower at 133,497 s.tons, compared with 135,213 s.tons in December. Deliveries were disappointing at 134,007 s.tons against 144,531 s.tons in December, and stocks showed an appreciable increase at 201,000 s.tons against 178,152 s.tons at the end of the previous month. The most disappointing feature is the rate of deliveries to consumers both inside and outside America, especially when one considers that the figures in January are compared with December, a month containing many days of holiday. Against this, however, it must be realized that stocks in America are still at a very low level, and the increase in stocks outside is probably accounted for by the refilling of the pipeline from Rhodesia to Europe, which was emptied during the recent strike.

I.T.C. DECISION AWAITED

The tin market has remained quiet in face of the Council meeting being held in London. Many opinions have been expressed as to the action the Council should take with regard to the next quarter's quota figure. The majority of market opinion is that the restriction on exports should remain unchanged for at least one more period, as by then it is felt that the buffer stock manager will have commenced to sell some of the real stockpile. It is generally believed that the major part of the Special Fund Tin has now been disposed of, and there are estimates in circulation which show that at present rates of consumption and export the buffer stock is not sufficient to bridge the gap for 1959 and therefore some major relief to producing countries can be expected during the second half of the year.

Stocks in official warehouses showed a further sharp fall of 723 l.tons at the beginning of the week, giving a total of 13,738 l.tons. The second annual report of the International Tin Council for the year ending June, 1958, shows that at that time the buffer stock amounted to 23,305 l.tons and that the cash resources had sunk to £242,000. On Thursday morning, the Eastern price was equivalent to £819¾ per ton c.i.f. Europe.

LEAD-ZINC PRICE DIFFERENTIAL MAY WIDEN

The lead and zinc markets have pursued their uneventful course, although a slightly firmer undertone was imparted by the news that the meeting of producer countries would now probably take place in April. Demand for zinc still remains satisfactory, but that for lead still leaves much to be desired, and it is considered possible that the present span between the two prices may increase.

Latest figures issued in connection with the United States import quotas show that for lead-bearing ores Australia, Bolivia, and Peru have already filled their quotas, while for lead itself the "other countries" quota is the only one filled. In zinc ores the "other countries" quota is filled, as is also the zinc quota for Belgium/Luxemburg, Italy, and "other countries".

It is understood that a committee is sitting to discuss the administration of the quotas, and it may be that for the next period there will be certain alterations for various countries. It is not expected that the overall figure of tonnage permitted into the U.S. will be increased.

Closing prices are as follows:

	Feb. 12		Feb. 19	
	Buyers	*Sellers*	*Buyers*	*Sellers*
COPPER				
Cash ..	£234½	£234¾	£237½	£237¾
Three months ..	£234½	£234¾	£237	£237½
Settlement ..	£234¼		£237½	
Week's turnover	9,125 tons		10,350 tons	
LEAD				
Current ½ month	£69⅞	£70	£70	£70¼
Three months ..	£70¼	£70⅜	£71⅛	£71¼
Week's turnover	8,300 tons		5,425 tons	
TIN				
Cash ..	£768	£768½	£772	£772½
Three months ..	£768½	£769	£774	£774½
Settlement ..	£768½		£772½	
Week's turnover	965 tons		1,315 tons	
ZINC				
Current ½ month	£73	£73¼	£74½	£74¾
Three months ..	£71¼	£71½	£72½	£73
Week's turnover	7,625 tons		5,825 tons	

London Metal and Ore Prices appear on inside back cover.

Mining Finance

M.T.D.'s First Year

The report and accounts of M.T.D. Mangula for the year to September 30, 1958, have now been published, and although the profit on the first year's working amounted to only £3,740, there are several factors which, taken in conjunction with the technical report, give no reason to change the high opinion held of this Southern Rhodesian copper producer.

The prime cause of the low earnings for the year was, of course, the exceptionally low copper price ruling for much of the period. At one time the price had fallen to almost £160 per ton, and by the end of the company's year the recovery had carried it up only as far as £212. From the acounts it would appear that the average received by M.T.D. for its 52 per cent concentrates during the year was equivalent to a copper price of £175 per ton. It is no mean achievement that any profit at all was earned by a mine in its first year of operation operating a more or less revolutionary method of treatment—Mangula is the first major copper concentrator to include an Aerofall mill in the flowsheet—and taking into consideration the fact that production began eighteen months ahead of schedule, albeit on a smaller scale than planned, the accomplishment of the company's engineers is remarkable.

This view is borne out by an examination of the general manager's report which accompanies the accounts. Such figures as 91 per cent recovery and 88.5 per cent of possible time worked by the concentrator would not be unsatisfactory for an established operation, and bearing in mind that the plant was treating a higher proportion of oxidic ore than will be the case when mill feed is coming from the lower levels of the mine, and that comparatively coarse grinding has been necessary while only one mill is in commission, the future of the mine appears bright indeed. The ore reserve position is satisfactory, and exploratory work continues to achieve good results.

There would seem to be little doubt that the profitability forecast in last year's formal offer for sale should be accomplished, if not exceeded, once the second Aerofall mill has been installed (this is expected to be completed during the current quarter) and the mine has worked up to its full production target of 3,000 tons of ore daily. However, the present share price of about 11s. 3d. takes full account of the future, and a more attractive way of taking an interest in Mangula is via the stock units of the parent Messina company. Messina is a dynamic company with diverse and growing interests, and at 110s., to yield almost 6 per cent, the units look interesting.

LONDON MARKET HIGHLIGHTS

A significant development in the South African gold share market during the week was the continued broadening of demand beyond the usual O.F.S. favourites. Yield considerations were coming more and more into play and interest consequently switched to the West Rand issues and to a smaller degree to the older mines. The result was a rise in shares such as Doornfontein (33s. 9d.), Vaal Reefs (41s. 3d. at one time) and S.A. Lands (22s. 6d.). As far as the O.F.S. was concerned, prices occasionally eased slightly. St. Helena, for instance, after reaching a twelve-year peak of 61s. 3d., later came back to 59s. 7½d.

On Tuesday, the market suffered from indigestion and prices quickly reacted as profit-taking developed. Indicative of the movement—which was welcomed by dealers often uncomfortably short of shares—was the tumble in Zandpan from a peak of 22s. 9d. to only 20s. 7½d. But the technical reaction was only in London, and on the following day Johannesburg buyers wasted no time in taking advantage of the cheaper prices being quoted here.

Zandpan promptly rebounded to 21s. 9d. and a strong demand from the Cape caused Loraine to jump 2s. 1½d. to 35s. 6d.; the rise was linked with talk of encouraging development values in the northern part of the Riebeeck area. Free State Geduld rallied 2s. 6d. to 148s. 9d. and rumours of better reef values in the deeper levels of the mine lifted Hartebeest 1s. 9d. to 66s. 9d.

Among the Finance Houses, Rand Selection strengthened to 51s. 6d. following the report and its news of a big improvement in net current assets. Consolidated Mines Selection rose to 45s. 6d. on the proposed scrip issue and General Mining (131s. 10½d.) moved up after the appearance of a jobber's circular drawing attention to the company's big stake in shares of the newer mines.

Diamonds moved narrowly, but De Beers (131s. 3d.) responded to a resurgence of Cape demand. The Rustenburg announcement of a higher platinum price took everybody unawares. Share values responded sharply to the news, Unions jumping 1s. 3d. to 10s. 1½d., Waterval 1s. to 11s. 7½d., and "Pots" 3d. to 7s. 4½d.

Demand for copper shares was again very selective. Chartered attracted fresh investment attention and advanced to 83s. 6d.: some of the buying was believed to be on behalf of unit trusts; a reasonable assumption in view of the popularity of this share with several newcomers to the trust movement. Messina issues were also sought after, the shares rising to 11!s. 10½d. on fresh consideration of the rise in market value of their big Mangula holding. Market estimates suggest that Messina may have sold well over 2,000,000 Mangula shares from its holding by now, and this could well be reflected in a higher interim dividend in April. Mangula themselves were steady at 11s. 3d., the first annual report being received with satisfaction. Bancroft (28s. 9d.) brightened, while Rhodesia-Katanga (17s. 3d.) came to life on hopes that the Kansanshi mine may be reopened this year.

BLYVOOR SHAFT WILL NOT CUT DIVIDEND

Blyvooruitzicht Gold Mining, Central Mining's representative on the West Wits line, is to sink a new 24 ft. shaft from surface at an estimated cost of £2,720,000 including £465,000 for pumping equipment. The new shaft, to be known as the No. 4 shaft, will be sunk to a final depth of 5,045 ft., the horizon of the 6 level haulage from which cross-cuts will be driven to serve the shaft. The shaft will be commissioned towards the end of 1963.

The shaft site is somewhat unusual in that it is situated outside Blyvoor's present lease area, about 3,200 ft. east of the No. 3 ventilation shaft. This position has been chosen in order to sink the shaft in intact ground, while at the same time avoiding locking up large tonnages of high-grade ore in unavailable reserves. Steps are being taken to extend the lease area to include the shaft site.

Also unusual is the fact that the area surrounding the No. 4 shaft is already fully developed. This serves to emphasize the reason for the new sinking operation, which is not, as is most frequently the case, to open up a new area, but rather to rationalize operations, both current and planned. Development at Blyvoor has proceeded down-dip over almost the entire east-west axis of the near rectangular lease area, so that by last June the developed area had formed a strip in the north of the lease area covering about one-third of Blyvoor's ground. Exploration further down-dip was being carried out from a series of sub-incline shafts collared on No. 6 level, and it must be assumed that the main purpose of the new shaft is to allow men, materials, and ore to be hoisted from these lower levels without adding to the load on the two timbered rectangular shafts at present in operation. There will also be an improvement in pumping and ventilation facilities. Some reduction in costs should therefore be apparent.

The company has stated that it will be able to finance the programme and other capital expenditure without encroaching on the present dividend rate of 2s. per annum. The possibility of an increase in this rate, however, must now look very small until the capital programme is completed.

PETALING MAY RESUME DIVIDENDS

After two years out of the dividend list, Petaling Tin may resume distributions at the end of the current year. This cheering news for shareholders is given by Petaling's chairman, Mr. J. T. Chappel, in his review of operations for 1958-59.

The cessation of dividends in 1956 was due to a combination of factors resulting in a quite sudden fall in distributable income. Among these factors were difficult dredging conditions and disappointing grade from the No. 5 dredge, operating in the Seaport area, low returns from the No. 6 dredge, which was working ground previously treated by the shallower No. 5 unit, and heavy capital expenditure on river deviation.

(*Continued on page 210*)

RAND SELECTION CORPORATION LIMITED

(Incorporated in the Union of South Africa)

A MOST SUCCESSFUL YEAR

The following are extracts from the statement by the Chairman, **Mr. Anthony Wilson**, which has been circulated with the annual report and accounts for the year ended September 30, 1958:

The outstanding feature of the period since my last review has been the revival of interest in investment in South Africa. The recent loan by the Deutsche Bank to the Anglo American Corporation, the formation of American-South African Investment Company Limited and the activity on the stock markets in Johannesburg and London in South African shares all indicate that this interest is both substantial in scale and international in complexion.

The resulting improvement in the level of prices of quoted shares in which we are interested has led to an increase in the market value of our quoted investments, including our holding in S.A. Townships, of £1,794,962, equal to about 12.34 per cent. This increase has taken place at the same time as a reduction in the book value of quoted investments of £362,864, equal to about 6.15 per cent. Favourable market conditions have continued since the end of the financial year.

The Year's Results

The profit for the year amounted to £1,332,351, which is £255,574 more than that for the previous year. This improvement is mainly attributable to a substantial increase in the income from our subsidiary and other quoted investments. Although profits were higher, the board decided to maintain the dividend at 2s. 6d. per share and the general reserve has been added to by an appropriation of £250,000 and now stands at £6,750,000.

During the past year, a very substantial improvement in the financial position has been brought about. As you know, we have an agreement with the Anglo American Corporation in terms of which that corporation offers us the opportunity to participate in any new business embarked on by it. It is the general policy of the board to accept these participations, which in normal times are financed partly out of retained profits and partly out of the proceeds of the disposal of existing shareholdings.

This process—the gradual switching over the years from shares in established companies into shares in new companies—which is so important if we are to continue our growth and maintain our virility, can become difficult if we are faced for any long period with stagnant market conditions. The over-invested position of this corporation at the end of the previous financial year, when current liabilities exceeded current assets by £485,545, illustrated this difficulty.

Recently, however, we have been able to improve greatly the liquid position of the corporation, and at the year-end current assets exceeded current liabilities by £168,725. This has resulted from the taking over by the Anglo American Corporation of certain loans to associated companies; from the disposal of shares to the market and to the American-South African Investment Company; and from the appropriation to the general reserve of £250,000.

Of the new business which has come to us recently by reason of our association with the Anglo American Corporation, I would like to mention particularly our participation in Western Deep Levels Limited. We have an interest in the company indirectly through West Rand Investment Trust and directly through our participation of 6¼ per cent in the syndicate which has lent £5,000,000 to the company.

This loan is convertible into shares at par and also carries sub-underwriting rights in respect of the offer of 4,750,000 "A" shares to be made in February, 1959. I attach great importance to our participation on ground-floor terms in this venture. By reason of its size and the values expected, particularly on the Carbon Leader, I am confident that it will prove to be a most profitable mine with a very long life.

This has been a period of great progress for our subsidiary company, South African Townships, Mining and Finance Corporation Limited. The profit for the year amounted to £367,035, an increase of no less than £141,441; and a dividend of 1s. per share was paid, compared with 6d. for the previous year.

South African Townships' major investment in all the gold-producing mines in the Orange Free State, held largely through an interest in Orange Free State Investment Trust Limited, is coming increasingly to fruition. Operations are being expanded in this goldfield and increased dividends from the producing mines enabled Orange Free State Investment Trust to increase its dividend by 1s. to 3s. 6d. per share. It is largely because of this increased revenue that our subsidiary has in turn been able to double its distribution.

In the Klerksdorp area, West Rand Investment Trust Limited declared dividends totalling 3s. per share for 1957 compared with 2s. for the previous year and an increased interim dividend of 1s. 3d. per share was declared in June.

The Diamond Industry

Anglo American Investment Trust, through which we hold an important interest in the De Beers Group of companies, maintained its dividend of 20s. per share. During 1958, the diamond industry has been adversely affected by the economic recession in the United States of America, which caused a decline in the demand for both gem and industrial stones and, as anticipated, the diamond sales in 1958 were lower than those in the previous year. Gem sales totalled £49,420,696 and industrial sales £16,122,693, making a total of £65,543,389.

In the circumstances, however, these figures must be looked on as highly impressive. Recently there has been evidence of a recovery and in a statement in November, Mr. H. F. Oppenheimer, the chairman of De Beers, said:

"Recently, sales of gem diamonds have been satisfactory and the industrial market has also improved to some extent. Every effort is being made to find new uses for diamonds in industry and to increase their efficiency.

"I am hopeful that these activities will lead to a permanently-expanded demand in the long run. Altogether the outlook for 1959 is encouraging."

The acquisition by De Beers of a half-interest in Williamson Diamonds Limited, is of great significance to the De Beers Group of companies and the diamond industry as a whole.

MINING FINANCE—*Continued*

In spite of tin restriction, the worst of this difficult period is now over. Only one dredge, the No. 6, is now in operation, and good returns are being achieved by it. The unit is, in fact, producing tin in excess of the combined quota for itself and the Nos. 3 and 4 dredges, and although last year's earnings of £24,493 are still a long way from the £477,722 earned in 1955, the cessation of expenditure on the Klang river deviation, now completed, means that a nominal dividend, at least, is now likely at the end of the current year. Petaling shares are currently on offer at about 5s.

ANGLO HOLDING COMPANY RESULTS

Consolidated Mines Selection, one of the holding companies in the Anglo American group, has declared a final dividend of 1s. 6d. per share, to make a total of 2s. 6d. for the year. Although this dividend is at the same rate as last year's declaration, it represents an increase of 10 per cent because a one-for ten scrip issue was made in March of last year. It is proposed that this issue should be repeated.

The increased effective dividend rate and the scrip issue are being made in spite of a fall in profit before tax from £392,398 to £340,754. It is, however, stated that the dividend for 1959 should be maintained at the 1958 level. The drop in profits is somewhat surprising, because about 75 per cent of the company's investments are in the S.A. gold industry, and these have provided increases in both income and capital sufficient to offset the corresponding declines in the copper section of the portfolio. In fact, the fall is almost entirely attributable to a £46,000 decline in profits from realizations, commission and interest. Further elucidation must await the chairman's statement.

In contrast, Rand Selection, another Anglo holding company, increased its taxed profit for 1958 to £1,332,351 from £1,076,777. In this case, the rise was attributable to improvements in all profit categories. The affairs of Rand Selection, which, like Consolidated Mines Selection, has an interest in all Anglo American's new business, are reviewed by the chairman, Mr. A. Wilson, on this page.

Konongo's Profits. — Konongo Gold Mines earned a profit after tax of £104,304 in the year to September 30 last. This is virtually the same as the previous year's result. The final dividend recommended is 4d. per share, to make 6d. for the year. Last year's payments totalled 8d., but 2d. of this was distributed from non-recurring tax credits. Meeting, March 24.

98 Per Cent Wanted Western Deep's Shares...—The rights offer of Western Deep Level shares at par, which closed on Monday, was subscribed to the extent of 98 per cent, leaving 2 per cent to be subscribed in terms of the underwriting agreement. Renouncable letters of allotment in respect of applications received in Johannesburg are being posted today.

. . . And 99 Per Cent Wanted West Wits.—The recent rights offer of West Witwatersrand Areas shares at 45s. was subscribed to the extent of 99 per cent.

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This feature appears every fourth week

Book Reviews

The Milling of Canadian Ores. *Published following the Sixth Commonwealth Mining and Metallurgical Congress, 1957, by the General Committee of the Sixth Commonwealth Mining and Metallurgical Congress.*

This description, covering 447 pages of large quarto (8 in. by 10½ in.), deals with every aspect of milling in Canada, and provides detailed accounts of a large number of plants as well as a history of milling in Canada, research and testing facilities, an outline of developments and a general description of the three chief areas. Subsequent chapters deal with the milling of gold, silver-cobalt, copper, lead-zinc, uranium, asbestos, and iron ores, as well as the milling of ores of the less common minerals and the beneficiation practice in Canadian coal mines.

As in other countries, there has been a trend to employ rod mills for the final stage of crushing prior to ball milling, and possibly it may have been adopted more generally than elsewhere, whilst on some plants scoop feeders have been replaced by feed chute discharging directly into the mills. The use of cyclones, however, does not appear to be as widespread, and there is a tendency to retain rake classifiers as a safeguard against tramp oversize.

The integration of flotation and magnetic separation with pyro-metallurgical processes by the International Nickel Company of Canada so that nickel sulphide, copper sulphide, and metallics can be separated from a matte which has been cooled under control, is a fascinating achievement which has replaced the Orford process. In some areas, talc is troublesome in flotation, and both sulphur dioxide and a mixture of guartec and pyrophosphate have been used to depress it.

As far as uranium is concerned, most plants employ sulphuric-acid leaching and ion exchange, but at the Beaverlodge mill of Eldorado Mining and Refining Ltd. carbonate leaching is used, using autoclaves and pachuca tanks.

This book is a most comprehensive account of up-to-date Canadian milling practice, containing a wealth of information which makes it well worthy of a place in the mineral dresser's library.

Crushing and Grinding—*a Bibliography. Department of Scientific and Industrial Research. Published by H.M. Stationery Office. 425 pp. 35s.*

In 1957 the D.S.I.R. published a bibliography on industrial drying which attracted considerable attention, and the success of this venture suggested that similar works on other unit operations would be worth while. It was therefore decided to start with crushing and grinding, and an advisory committee was set up in 1953 resulting in the publication of a most useful volume this year.

Apart from the bibliography, which consists of some 2,800 references, accompanied by abstracts and annotations, and divided under fundamental aspects, crushing and grinding practice, equipment, coarse reduction, fine reduction, non-mechanical methods, materials, methods of particle size and surface area determination, classification, and dust and fire hazards; short reviews covering both the fundamental aspect and the application of crushing and grinding in various industries are provided which give an excellent picture of the present state of knowledge on the subject.

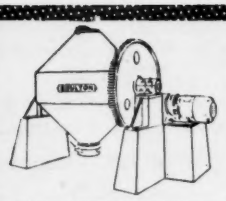
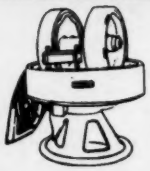
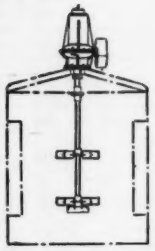
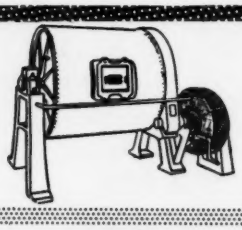
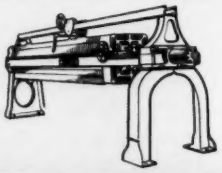
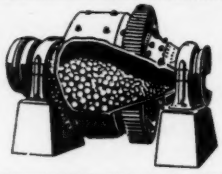
Unfortunately, this volume was published too early to include any reference to the recent excellent monograph by H. E. Rose, but the reader will find a great deal both of interest and of considerable practical value in these reviews, quite apart from the bibliography.

★

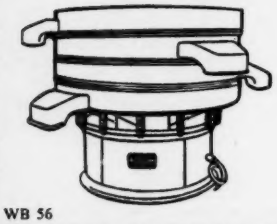
A comprehensive survey of the platinum laboratory apparatus and electrodes in the Johnson, Matthey and Co. Ltd. range, and useful advice on care and maintenance, are included in a new publication, *1700—Platinum Laboratory Apparatus.* The booklet revises and combines the earlier issues, 1710 and 1720, and is available on application to the publicity department at the company's head office at 73-83 Hatton Garden, E.C.1.

★

The final map of a series of four, showing the results of an airborne magnetic and radiometric survey in Australia which was made by the Bureau of Mineral Resources in the vicinity of Tennant Creek during 1956, has now been printed. This map, in the series of *Tennant Creek Air Survey Maps*, is a comprehensive one and shows on a reduced scale of two miles to one inch the results of three previously published separate maps of the Tennant Creek, Mount Woodcok, and parts of Marion Ross and Red Bluff areas. In addition, strips of country containing 800 square miles, and adjacent to the previous areas on the north, east, and south sides, have been included.

Boulton Machines for the Mining Industry



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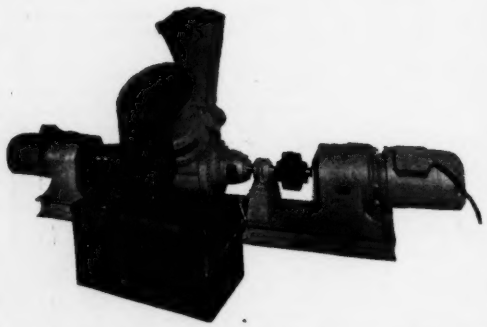

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